

## **Relationship between lower extremity muscle strength, balance performance and mental health in children aged 6–10 years.**

**Dr. Amogh R. Kulkarni (PT)\***

Assistant Professor, TMV's Indutai Tilak College of Physiotherapy, Pune, Maharashtra,  
India

**Abstract: Background:** Children are at a greater risk of sustaining falls and sports-related injuries due to an underdeveloped neuromuscular system and ongoing motor skill acquisition. Lower levels of balance and muscular strength have been reported in children compared to healthy young adults. In addition to physical factors, emerging evidence suggests that psychological well-being may influence motor performance and participation in activities.

**Objective:** To determine the relationship between lower extremity muscle strength, balance performance, and mental well-being in typically developing children aged 6–10 years, and to evaluate the influence of age and gender on these variables.

**Methodology:** A total of 150 children (75 males and 75 females) were randomly included in the study. Demographic data including age and gender were recorded. Balance was assessed using the Paediatric Berg Balance Scale (PBBS) and the Community Balance and Mobility Scale (CB&MS). Lower limb muscle strength was measured using a Hand-Held Dynamometer (HHD). Mental well-being was assessed using the Pediatric Quality of Life Inventory. The best of three trials was recorded for physical performance measures. Statistical analysis was performed using Pearson's correlation coefficient.

**Results:** A statistically significant relationship was observed between lower limb muscle strength and balance performance on PBBS scores for hip flexors ( $p = 0.0026$ ), extensors ( $p = 0.0066$ ), abductors ( $p = 0.0021$ ), adductors ( $p = 0.0047$ ), and knee extensors ( $p = 0.0397$ ). Similarly, significant correlations were noted between muscle strength and CB&MS scores across multiple muscle groups. Additionally, moderate positive correlations were observed between balance performance and PedsQL scores, indicating that children with better balance and strength demonstrated higher quality of life and psychosocial well-being. Females showed better performance in both balance and mental health scores compared to males.

**Conclusion:** Lower extremity muscle strength is significantly associated with balance performance in children aged 6–10 years. Furthermore, both strength and balance are positively related to mental well-being. These findings highlight the importance of incorporating psychological assessment alongside physical evaluation in pediatric populations.

**Keywords:** Lower limb muscle strength, Balance, Mental well-being, HHD, CB&MS, PBBS, Pediatric Quality of Life Inventory, Typically developing children

### **INTRODUCTION**

Children are at a greater risk of sustaining falls and sports-related injuries compared to healthy young adults due to an underdeveloped neuromuscular system and the ongoing acquisition of fundamental motor skills<sup>1</sup>. Reduced levels of balance and muscle strength

have been consistently reported in children when compared to adults<sup>2,3</sup>. Additionally, a concerning decline in strength and balance performance has been observed over the past 35–40 years in the pediatric population<sup>4,5</sup>. Maintaining balance is essential during childhood, as it forms the foundation for the development of higher motor skills and functional independence. Therefore, assessing balance and muscle strength is crucial for early identification of deficits and implementation of targeted interventions.

Despite its clinical importance, there is a relative paucity of literature exploring the relationship between balance and muscle strength in children, particularly in the pre-pubertal age group. For instance, UrsGranacher et al. reported non-significant correlations between balance training and improvements in postural sway<sup>6</sup>. Similarly, I Holm conducted a study to establish normative values for muscular strength, power, and endurance in children aged 7–12 years<sup>7</sup>. In contrast, Thomas Muehlbauer and colleagues demonstrated a positive relationship between isometric and dynamic leg muscle strength, balance, and mobility in children aged 7–10 years<sup>8</sup>.

Furthermore, balance in everyday activities is often performed under both single-task and dual-task conditions. Successful performance in dual-task situations requires increased attentional demand and cognitive processing for effective postural control<sup>9</sup>. Olivier et al. demonstrated that children exhibit greater postural sway under dual-task conditions compared to single-task performance<sup>10</sup>. This highlights the important role of cognitive and psychological factors in maintaining balance.

In recent years, there has been growing recognition of the interaction between physical performance and mental well-being in children. Psychological factors such as attention, emotional regulation, and social participation can influence motor performance, while poor physical abilities may contribute to reduced self-esteem, decreased participation, and behavioral concerns. Therefore, incorporating a standardized measure of mental health, such as the Pediatric Quality of Life Inventory, provides a more comprehensive understanding of a child's overall functional status.

Therefore, the objectives of this study were three-fold. First, to investigate the relationship between lower extremity muscle strength and balance performance in typically developing children aged 6–10 years. Second, to examine the association between physical performance (muscle strength and balance) and mental well-being. Third, to generate clinically relevant

data that may assist therapists in designing comprehensive intervention programs targeting both physical and psychosocial domains in children.

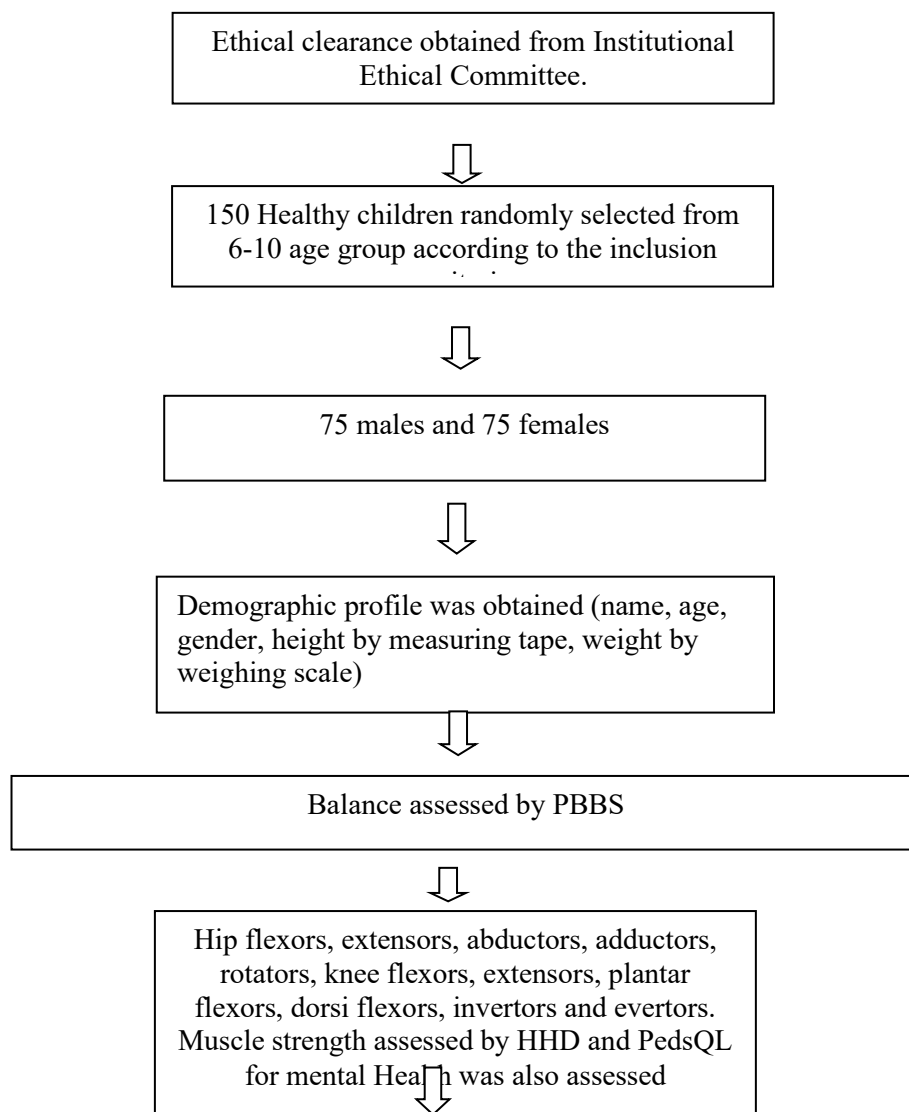
## **MATERIALS AND METHODS USED:**

### **Materials used**

Adjustable height bench, One chair with arm rest, stop watch, 12 inch long masking tape, Bright colored object or Flash cards, A chalkboard eraser, A ruler, Average size laundry basket, 2lbs and 7 ½ lbs weight, Visual target, Bean bag, Pen.

**Tools/Instruments:** PBBS, CB&MS, HHD, PedsQL Questionnaire, Data Collection sheet, Informed Assent form, Metal measuring tape, Weighing Scale.

## **METHODOLOGY**



Balance again assessed by CB&MS.



Best out of three trials was considered for all.

**Statistical analysis:** The association between strength and balance was assessed using Statistical Package of Social Sciences (SPSS) version 21 so as to verify the results. Various Data (mean deviation, standard deviation, paired and unpaired t-test) was used. Correlation of CB&M, PBBS and muscle strength were done using Karl Pearson's Correlation Coefficient. Correlation between Balance performance and muscle strength was assessed. Probability values of less than 0.05 were considered statistically significant.

## RESULTS:

### *Strength performance:*

A significant positive correlation was seen between lower extremity muscle strength and the age of the child. (Table 1).

**Table 1: Comparison of ages with muscle strength at different places by one way ANOVA**

| Variables | Summary | 6yrs | 7yrs | 8yrs | 9yrs | 10yrs | Total | F-value | p-value |
|-----------|---------|------|------|------|------|-------|-------|---------|---------|
| Hip flex. | Mean    | 9.29 | 8.95 | 9.31 | 9.35 | 9.70  | 9.30  | 0.5401  | 0.7065  |
|           | SD      | 2.36 | 1.93 | 2.13 | 1.80 | 2.51  | 2.15  |         |         |
| Hip ext.  | Mean    | 8.71 | 8.21 | 8.33 | 9.43 | 10.05 | 8.89  | 4.4834  | 0.0019* |
|           | SD      | 2.58 | 1.98 | 1.58 | 1.99 | 2.35  | 2.19  |         |         |
| Hip intr. | Mean    | 6.84 | 7.12 | 7.33 | 8.13 | 7.95  | 7.45  |         |         |

|               |      |          |          |          |          |           |      |             |             |
|---------------|------|----------|----------|----------|----------|-----------|------|-------------|-------------|
|               | SD   | 1.4<br>7 | 1.5<br>1 | 1.2<br>4 | 1.6<br>6 | 1.79      | 1.59 | 3.4388      | 0.0102<br>* |
| Hip extr.     | Mean | 6.4<br>0 | 6.9<br>4 | 7.1<br>1 | 7.9<br>3 | 8.05      | 7.28 | 6.3337      | 0.0001<br>* |
|               | SD   | 1.4<br>9 | 1.2<br>5 | 1.2<br>5 | 1.6<br>6 | 1.64      | 1.55 |             |             |
| Hip abd.      | Mean | 7.6<br>5 | 7.7<br>3 | 7.6<br>4 | 8.5<br>7 | 8.91      | 8.08 | 3.2184      | 0.0145<br>* |
|               | SD   | 1.8<br>7 | 1.8<br>2 | 1.6<br>9 | 1.7<br>9 | 1.94      | 1.88 |             |             |
| Hip add.      | Mean | 7.4<br>2 | 7.3<br>3 | 7.7<br>8 | 8.4<br>6 | 8.86      | 7.94 | 4.9455      | 0.0009<br>* |
|               | SD   | 1.4<br>8 | 1.4<br>7 | 1.6<br>7 | 1.6<br>5 | 1.99      | 1.75 |             |             |
| Knee flex     | Mean | 7.0<br>8 | 7.4<br>4 | 7.8<br>3 | 8.8<br>7 | 9.73      | 8.17 | 11.042<br>7 | 0.0001<br>* |
|               | SD   | 1.3<br>6 | 1.2<br>9 | 1.5<br>0 | 2.1<br>0 | 2.52      | 2.03 |             |             |
| Knee ext.     | Mean | 7.8<br>5 | 8.3<br>3 | 8.3<br>8 | 9.8<br>0 | 10.0<br>0 | 8.85 | 5.8716      | 0.0002<br>* |
|               | SD   | 1.3<br>8 | 2.2<br>1 | 1.4<br>1 | 2.5<br>7 | 2.59      | 2.24 |             |             |
| Ank dosr      | Mean | 7.0<br>2 | 7.5<br>0 | 7.4<br>7 | 8.8<br>0 | 9.55      | 8.05 | 9.3440      | 0.0001<br>* |
|               | SD   | 1.5<br>6 | 1.5<br>3 | 1.4<br>9 | 1.9<br>8 | 2.64      | 2.09 |             |             |
| Ankl plan     | Mean | 6.5<br>4 | 7.5<br>3 | 7.4<br>2 | 8.2<br>6 | 9.11      | 7.80 | 7.5739      | 0.0001<br>* |
|               | SD   | 1.3<br>8 | 1.1<br>8 | 1.6<br>7 | 2.5<br>0 | 2.43      | 2.02 |             |             |
| Inversio<br>n | Mean | 6.1<br>3 | 6.6<br>8 | 7.0<br>5 | 8.1<br>1 | 8.36      | 7.25 | 10.296<br>1 | 0.0001<br>* |
|               | SD   | 1.5<br>6 | 1.2<br>0 | 1.3<br>2 | 2.0<br>4 | 1.78      | 1.75 |             |             |
| Eversion      | Mean | 5.8<br>1 | 6.5<br>0 | 6.8<br>3 | 8.2<br>2 | 7.92      | 7.03 |             |             |

|  |    |          |          |          |          |      |      |             |             |
|--|----|----------|----------|----------|----------|------|------|-------------|-------------|
|  | SD | 1.5<br>0 | 1.2<br>1 | 1.5<br>0 | 2.0<br>3 | 1.64 | 1.75 | 10.927<br>8 | 0.0001<br>* |
|--|----|----------|----------|----------|----------|------|------|-------------|-------------|

\*p<0.05

There was statistical significant relationship between gender and muscle strength.(Table 2)

**Table 2: Comparison of male and females with muscle strength at different places by t test**

| Variables | Summary | Male | Female | Total | t-value | p-value |
|-----------|---------|------|--------|-------|---------|---------|
| Hip flex. | Mean    | 8.72 | 9.88   | 9.30  | 3.4239  | 0.0008* |
|           | SD      | 2.26 | 1.87   | 2.15  |         |         |
| Hip ext.  | Mean    | 8.07 | 9.69   | 8.89  | 4.8425  | 0.0001* |
|           | SD      | 1.93 | 2.15   | 2.19  |         |         |
| Hip intr. | Mean    | 7.03 | 7.86   | 7.45  | 3.2724  | 0.0013* |
|           | SD      | 1.31 | 1.74   | 1.59  |         |         |
| Hip extr. | Mean    | 6.77 | 7.77   | 7.28  | 4.1697  | 0.0001* |
|           | SD      | 1.21 | 1.68   | 1.55  |         |         |
| Hip abd.  | Mean    | 7.28 | 8.85   | 8.08  | 5.6083  | 0.0001* |
|           | SD      | 1.46 | 1.92   | 1.88  |         |         |
| Hip add.  | Mean    | 7.26 | 8.60   | 7.94  | 5.0323  | 0.0001* |
|           | SD      | 1.39 | 1.83   | 1.75  |         |         |
| Knee flex | Mean    | 7.65 | 8.68   | 8.17  | 3.2288  | 0.0015* |
|           | SD      | 1.63 | 2.24   | 2.03  |         |         |
| Knee ext. | Mean    | 8.21 | 9.47   | 8.85  | 3.5625  | 0.0005* |
|           | SD      | 1.60 | 2.59   | 2.24  |         |         |
| Ank dosr  | Mean    | 7.22 | 8.87   | 8.05  | 5.2685  | 0.0001* |
|           | SD      | 1.33 | 2.35   | 2.09  |         |         |
| Ankl plan | Mean    | 7.03 | 8.55   | 7.80  | 4.9501  | 0.0001* |

|           |      |      |      |      |        |         |
|-----------|------|------|------|------|--------|---------|
|           | SD   | 1.28 | 2.32 | 2.02 |        |         |
| Inversion | Mean | 6.60 | 7.88 | 7.25 | 4.7764 | 0.0001* |
|           | SD   | 1.28 | 1.92 | 1.75 |        |         |
| Eversion  | Mean | 6.20 | 7.83 | 7.03 | 6.4094 | 0.0001* |
|           | SD   | 1.08 | 1.91 | 1.75 |        |         |

There was also a significant correlation noted between Muscle strength of Hip flexors, extensors, abductors, adductors and knee extensors and PBBS Scale Score. (Table 3)

**Table 3: Correlation between paediatric berg balance scale scores with muscle strength at different places by Karl Pearson's correlation coefficient.**

| Variables | Correlation between Paediatric berg balance scale scores with |         |         |
|-----------|---------------------------------------------------------------|---------|---------|
|           | r-value                                                       | t-value | p-value |
| Hip flex. | 0.2442                                                        | 3.0632  | 0.0026* |
| Hip ext.  | 0.2208                                                        | 2.7547  | 0.0066* |
| Hip intr. | 0.0742                                                        | 0.9047  | 0.3671  |
| Hip extr. | 0.1280                                                        | 1.5699  | 0.1186  |
| Hip abd.  | 0.2489                                                        | 3.1259  | 0.0021* |
| Hip add.  | 0.2296                                                        | 2.8702  | 0.0047* |
| Knee flex | 0.1094                                                        | 1.3388  | 0.1827  |
| Knee ext. | 0.1681                                                        | 2.0747  | 0.0397* |
| Ank dosr  | 0.1392                                                        | 1.7102  | 0.0893  |
| Ankl plan | 0.0875                                                        | 1.0680  | 0.2873  |
| Inversion | 0.0480                                                        | 0.5844  | 0.5598  |
| Eversion  | 0.1217                                                        | 1.4915  | 0.1380  |

\*p<0.05

There was also a significant correlation noted between muscle strength of Hip extensors, external rotators, abductors, adductors, knee flexors, extensors, ankle dorsi flexors, invertors and evertors and CB&M Scale scores. (Table 4)

**Table 4: Correlation between community balance & mobility scores with muscle**

strength at different places by Karl Pearson's correlation coefficient.

| Variables | Correlation between community balance & mobility scores with |         |         |
|-----------|--------------------------------------------------------------|---------|---------|
|           | r-value                                                      | t-value | p-value |
| Hip flex. | 0.1561                                                       | 1.9224  | 0.0565  |
| Hip ext.  | 0.1847                                                       | 2.2865  | 0.0236* |
| Hip intr. | 0.0724                                                       | 0.8837  | 0.3783  |
| Hip extr. | 0.1823                                                       | 2.2560  | 0.0255* |
| Hip abd.  | 0.2388                                                       | 2.9922  | 0.0032* |
| Hip add.  | 0.2120                                                       | 2.6394  | 0.0092* |
| Knee flex | 0.1769                                                       | 2.1869  | 0.0303* |
| Knee ext. | 0.1735                                                       | 2.1428  | 0.0338* |
| Ank dosr  | 0.1875                                                       | 2.3219  | 0.0216* |
| Ankl plan | 0.1383                                                       | 1.6988  | 0.0915  |
| Inversion | 0.1599                                                       | 1.9711  | 0.0500* |
| Eversion  | 0.2332                                                       | 2.9173  | 0.0041* |

\*p<0.05

There was a positive correlation between PBBS and CB&M Scale scores with muscle strength of all muscles.[p=0.0001] ( Table 5)

**Table 5: Correlation between pediatric berg balance scale and community balance & mobility scores with muscles at different place by Karl Pearson's correlation coefficient**

| Variables                    | Correlation between Community balance & mobility scores with |         |         |
|------------------------------|--------------------------------------------------------------|---------|---------|
|                              | r-value                                                      | t-value | p-value |
| Pediatric berg balance scale | 0.4197                                                       | 5.6252  | 0.0001* |

\*p<0.05

**Table 6: Comparison of Ages with PedsQL Scores by One-Way ANOVA**

| Variable<br>s       | Summary | 6<br>yrs  | 7<br>yrs  | 8<br>yrs  | 9<br>yrs  | 10<br>yrs | Total     | F-<br>value | p-<br>value |
|---------------------|---------|-----------|-----------|-----------|-----------|-----------|-----------|-------------|-------------|
| PedsQL<br>Emotional | Mean    | 73.2<br>1 | 74.8<br>8 | 75.9<br>6 | 76.8<br>5 | 78.1<br>2 | 75.8<br>0 | 2.91        | 0.023<br>*  |
|                     | SD      | 10.5<br>4 | 9.87      | 9.42      | 10.1<br>1 | 9.76      | 9.94      |             |             |
| PedsQL<br>Social    | Mean    | 75.6<br>4 | 76.9<br>2 | 78.1<br>0 | 79.2<br>5 | 80.3<br>3 | 78.0<br>5 | 2.47        | 0.046<br>*  |
|                     | SD      | 9.88      | 9.21      | 8.76      | 9.34      | 8.95      | 9.23      |             |             |
| PedsQL<br>School    | Mean    | 69.4<br>5 | 70.8<br>8 | 72.1<br>5 | 73.9<br>6 | 75.0<br>2 | 72.6<br>9 | 3.12        | 0.017<br>*  |
|                     | SD      | 11.2<br>2 | 10.9<br>5 | 10.4<br>8 | 10.2<br>1 | 10.6<br>7 | 10.7<br>1 |             |             |
| PedsQL<br>Total     | Mean    | 72.7<br>7 | 74.2<br>2 | 75.4<br>0 | 76.6<br>8 | 77.8<br>2 | 75.5<br>1 | 3.05        | 0.019<br>*  |
|                     | SD      | 9.84      | 9.21      | 8.95      | 9.12      | 9.33      | 9.29      |             |             |

There was a statistically significant difference observed between age groups and PedsQL scores. Total PedsQL scores increased with age ( $p = 0.019$ ), indicating improved quality of life in older children.

Additionally, females demonstrated significantly higher PedsQL scores compared to males ( $p = 0.009$ ), suggesting better psychosocial functioning.

## DISCUSSION

In fact, according to Bosco C et al and Hytonen M et al.<sup>11</sup> lower performance levels have been noted in children compared to young healthy individuals. Further, a significant decline in standing long jump performance was also observed in boys and girls aged 6-17 years by Bos K et al.<sup>12</sup> Therefore, this study was undertaken in age group 6-10 years as children in this group are more at risk.

Horak and Nashner,<sup>13</sup> described three primary movement strategies used by healthy adults to recover balance in response to sudden perturbations of the supporting system called ankle, hip and stepping strategies that being pre-programmed muscle synergies compromise the fundamental movement unit used to restore balance.

In quiet stance and during small perturbations movements at the ankle act to restore person's COM to a stable position. For small external perturbations, muscle activity usually proceeds from gastrocnemius followed by hamstrings and finally Para spinal muscle activation. In response to backward instability, muscle activity begins in the anterior tibialis, followed by quadriceps and abdominal muscles.

The hip strategy uses rapid hip flexion -extension to move the COM within the BOS. In response to forward body sway, muscles are typically activated by abdominals followed by quadriceps and in backward body sway results in activation of para spinals followed by the hamstrings.

If a large force displaces the COM beyond the limits of stability, a forward or backward step is used to enlarge the BOS and regain balance control.

As mentioned above the muscles of lower limb are important to maintain balance. Therefore, Strength of 12 lower limb muscle groups namely Hip flexors, extensors, abductors, adductors, hip rotators, Knee flexors-extensors, dorsi flexors, plantar flexors, invertors and evertors was assessed in our study.

Balance was assessed using PBBS and CB&MS.

As these scales had items like sitting to standing which involves muscle activity of quadriceps, hamstring, gastrocnemius and Gluteus and activity like backward walking which includes Glutei, hamstrings, quadriceps and plantar flexors.

In this study balance was assessed by PBBS and CB&M Scale for typically developing children of age 6-10 years. Whereas, in the study by Shu-Mei Chen et al.<sup>14</sup> Balance was assessed by Bruininks Oseretsky test of Motor Proficiency (BOTMP). Franjoine et al.<sup>15</sup> determined the test-retest and interrater reliability of PBBS. Even the CB&MS which is used in our study was used by Wright et al. in assessing balance in children with Acquired Brain Injury and showed excellent reliability

In the present study age group was taken 6-10 years as Beth A. Foudriat et al.<sup>16</sup> suggested that the predominance of visual-vestibular control of balance gives a way to somatosensory-vestibular dependence by age 3, but transition to adult like balance responses is not complete for all sensory conditions even by 6. According to the outcome measures in present

study the scores of PBBS for 6 years age was 54.33 whereas for 10 years of age was 54.63, also Balance score by CB&MS for 6 years of age was 92.71 whereas for 10 years of age was 94.19 which showed that balance score was greater in 10 years of age as compared to 6 years of age. Also a study by Christina Rival et al.<sup>17</sup> showed that with age, the COP decreased with a maximum at 8 years of age, whereas the speed of COP decreased linearly from 6-10 years of age, and at overtime both parameters decreased and stabilized. The process underlying the maintenance of an optimal postural stability are mature at least as soon as 6 years.

Several studies involving association between lower limb muscle strength and balance have measured muscle strength by a one-dimensional force platform, (UrsGrancher et al) but in our study we have measured muscle strength using a Hand-Held Dynamometer. Muscle strength can be estimated by observational methods as well as by laboratory examinations with isokinetic instruments. In clinical practice mostly Manual Muscle Testing (MMT) is used but it is not a sensitive method to detect muscle changes especially grade 4 and grade 5. Therefore, using a Hand-Held Dynamometer can give more reliable values. (Meta NY Strom).

According to Knutson LM et al.<sup>18</sup> before selecting the instrument the specifications of HHD should be known for the most accurate strength measurements and HHD range and sensitivity should match the forces produced by the participants. In our study HHD ranges were compatible with the muscle forces generated by 6-10 years old children. As standard procedures were followed HHD proved to be reliable. Strength values were taken after simple, clear verbal instructions and best one out of the three trials were noted.

In present study it was also noted that females have greater muscle strength than that of males. All the 12 muscle groups of lower limb i.e., Hip flexors, extensors, abductors, adductors, internal rotators, external rotators, Knee flexors-extensors, dorsi flexors, plantar flexors, invertors and evertors had more strength when measured by HHD in females than in males. Wai-Yi Wang et al.<sup>19</sup> study also proposed that female's lower limb muscle strength from 9-12 years of age was greater than males of the same age group, unlike in the study done by Loovis EM et al.<sup>20</sup> males did not perform well than females. Therefore, our data indicated that gender and age may not necessarily be the decisive factors associating to balance performance in children aged 6-10 years.

In present study, balance of females were again better than that of males. Balance is generally maintained by visual and vestibular function. According to Shin-ichi Hirabayashi et al,<sup>21</sup> the visual function followed and reached the adult level at the age of 15 years. The vestibular function develops later, showing a considerably lower level even at the age of 15 years. Girls were superior to boys with respect to the vestibular function at the age of 7-8 years.

In study of Wai-Yi Wang et al,<sup>19</sup> he concluded that there was a significant positive correlation between Balance and Dynamic strength and also between Dynamic strength and static strength by Spearman correlation analysis. In this study by Karl Pearson's correlation coefficient there was a positive correlation between Hip flexors ( $p=0.0026$ ), extensors ( $0.0066$ ), abductors ( $0.0021$ ), adductors ( $0.047$ ) and knee extensors ( $p=0.0397$ ) with Balance assessed by PBBS scores.

There was a positive relationship between variables of power and isometric strength by Thomas Muehlbauer et al in young adults.<sup>22</sup> Similarly, there was a positive correlation between muscle strength of Hip extensors, external rotators, abductors, knee flexors-extensors, dorsi flexors, invertors and evertors and balance assessed by CB&MS scores.

In present study there was positive significant correlation between PBBS and CB&MS with  $p=0.0001$ .

In summary, this study showed the muscle strength of lower extremities in children aged 6-10 years. Gender and age were found as important variable in this study. The muscle strength of females between 6-10 years is greater than males of same age, also the balance scores of PBBS and CB&M were more in females than males. Balance scores were better in 10 years of children than in 6 years of age.

There was positive correlation between muscle strength of few muscle groups and balance by PBBS and CB&MS.

Mental health plays a crucial role in the overall development and functional performance of children, influencing not only emotional and behavioural outcomes but also physical capabilities. Emerging evidence suggests that children with better psychological well-being tend to demonstrate higher levels of physical activity, improved motor coordination, and greater muscle strength. Conversely, children experiencing emotional difficulties, anxiety, or attention deficits may exhibit reduced participation in physical activities, leading to

decreased lower limb muscle strength and poorer motor performance. Psychological factors such as motivation, self-esteem, and attention are essential for optimal neuromuscular activation and motor learning, which directly affect strength development. Furthermore, reduced muscle strength may limit a child's ability to engage in play and social interaction, potentially contributing to negative mental health outcomes, thereby creating a bidirectional relationship. Thus, lower limb muscle strength and mental health are interconnected domains, where impairments in one may influence the other, highlighting the importance of a holistic assessment approach in paediatric populations.

## CONCLUSION

Muscle strength is related to balance as evident from the results with children having less strength performing poor on PBBS and CB&M Scale. Balance is also influenced by gender where females had better balance.

## Acknowledgement:

We would like to express our indebtedness to KLEU Institute of Physiotherapy. We would also like to thank all the participants in this study without whom this study would have been impossible.

---

## References

1. Williams HG, Pfeiffer KA, O'Neill JR, Dowda M, McIver KL, Brown WH, et al. Motor skill performance and physical activity in preschool children. *Obesity* (Silver Spring) 2008;16:1421–6.
2. Motor skill performance and physical activity in preschool children. *Obesity* (Silver Spring) 2008;16:1421–6.
3. Bosco C, Komi PV. Influence of aging on the mechanical behavior of leg extensor muscles. *European Journal of Applied Physiology and Occupational Physiology* 1980;45:209–19.
4. Hytonen M, Pyykko I, Aalto H, Starck J. Postural control and age. *Acta Otolaryngologica* 1993;113:119–22.

5. Bö s K. Motorische Leistungsfähigkeit von Kindern und Jugendlichen. In: Schmidt W, Hartmann-Tews I, Brettschneider W-D, editors. Erster Deutscher Kinder- und Jugendsportbericht. Schorndorf: Karl Hofmann; 2003. p. 85–107.
6. Jurimae T, Volbekiene V, Jurimae J, Tomkinson GR. Changes in Eurofit test performance of Estonian and Lithuanian children and adolescents (1992– 2002). *Medicine and Sport Science* 2007;50:129–42.
7. Granacher U, Muehlbauer T, Maestrini L, Zahner L, Gollhofer A. Can balance training promote balance and strength in prepubertal children? *The Journal of Strength and Conditioning Research* 2011;25:1759–66.
8. Holm I, Fredriksen PM, Fosdahl M, Vøllestad N. A normative sample of isotonic and isokinetic muscle strength measurements in children 7 to 12 years of age. *Acta Paediatrica*. 2008 May 1;97(5):602-7
9. Muehlbauer T, Besemer C, Wehrle A, Gollhofer A, Granacher U. Relationship between strength, balance and mobility in children aged 7–10 years. *Gait & posture*. 2013 Jan 31;37(1):108-12.
10. Woollacott M, Shumway-Cook A. Attention and the control of posture and gait: a review of an emerging area of research. *Gait and Posture* 2002;16:1–14.
11. Olivier I, Cuisinier R, Vaugoyeau M, Nougier V, Assaiante C. Age-related differences in cognitive and postural dual-task performance. *Gait and Posture* 2010;32:494–9.
12. Bosco C, Komi PV. Influence of aging on the mechanical behaviour of leg extensor muscles. *European Journal of Applied Physiology and Occupational Physiology*. 1980 Dec 1;45(2-3):209-19.
13. Bö s K. Motorische Leistungsfähigkeit von Kindern und Jugendlichen. Erster Deutscher Kinder- und Jugendsportbericht. 2003;3:85-107.
14. Exercises for Impaired Balance, “Carolyn Kisner, PT, MS in (Author), Lynn Allen Colby: PT, MS in (Author); *Therapeutic Exercises* 5<sup>th</sup> edition, New Delhi; 2007
15. Wang WY, Chen SM. Balance and muscular strength in normal children aged 9-12 years. *Kaohsiung Journal of Medical Sciences*. 1999 Apr;15:226-33.

16. Franjoine MR, Gunther JS, Taylor MJ. Paediatric balance scale: a modified version of the berg balance scale for the school-age child with mild to moderate motor impairment. *Paediatric Physical Therapy*. 2003 Jul 1;15(2):114-28.
17. Foudriat BA, Di Fabio RP, Anderson JH. Sensory organization of balance responses in children 3–6 years of age: a normative study with diagnostic implications. *International Journal of Paediatric Otorhinolaryngology*. 1993 Oct 31;27(3):255-71.
18. Rival C, Ceyte, H. And Olivier, I., 2005. Developmental changes of static standing balance in children. *Neuroscience letters*, 376(2), pp. 133-136
19. Macfarlane TS, Larson CA, Stiller C. Lower extremity muscle strength in 6-to 8-year-old children using hand-held dynamometry. *Paediatric Physical Therapy*. 2008 Jul 1;20(2):128-36.
20. Wang WY, Chen SM. Balance and muscular strength in normal children aged 9-12 years. *Kaohsiung Journal of Medical Sciences*. 1999 Apr;15:226-33.
21. Loovis, Edwin Michael, and Walter F. Ersing. "Assessing and programming gross motor development for children." (1979).
22. Hirabayashi SI, Iwasaki Y. Developmental perspective of sensory organization on postural control. *Brain and development*. 1995 Apr 30;17(2):111-3.
23. Granacher U, Meuhlbauer T, Maestrini L, Gollhofer A. Can balance and strength in pre pubertal children?. *The Journal of Strength & Conditioning Research*. 2011 Jun 1;25(6):1759-66.