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## **Bone Mineral Density of Children with Cerebral Palsy in the Age Group 7 to 14 Years**

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### ABSTRACT:

Cerebral palsy children have increased tendency to develop fractures later in life, for which low bone mineral density might be one of the factors. The aim of this study was to evaluate the bone mineral density in children with cerebral palsy and factors affecting it. A total of 82 diagnosed children with cerebral palsy were sampled by non-probability purposive sampling from the outpatient department of Armed Forces Institute of Rehabilitation Medicine. Bone mineral density (BMD), z-score was measured at lumbar spine with Dual Energy X Ray Absorptiometry (DEXA) at L1- L4 lumbar vertebra. Analysis was done using SPSS (Version 20). Statistical comparisons were made using independent sample t-test. Of the 82 children 37 (45.1%) were males and 45 (54.9%) females. The mean age for all the children was 5.6 + 2.34 years and mean BMDz- score was -2.12 + 0.67. There were statistically significant differences in BMDz score with respect to age groups, pattern of involvement and ambulation status ( $p < 0.05$ ) but there were no statistically significant differences in gender, physical therapy programme and nutritional status ( $p > 0.05$ ). The BMDz-scores were lower, especially in the quadriplegic and non-ambulant children. BMD if identified early and managed timely can prevent future fragility fracture risk and avoid delay in rehabilitation process.

**Keywords:** Cerebral Palsy, Bone Density, Absorptiometry, Photon

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**INTRODUCTION:**

Cerebral palsy (CP) is the most common causes of motor disability in childhood [1]. In Asian population the prevalence of cerebral palsy is 1/1000. In Pakistan spastic CP comprises 90.2% of all cases which includes quadriplegic, diplegic and hemiplegic types [2]. These children also frequently experience health problems such as epilepsy, recurrent pulmonary infections, gastro-esophageal reflux, constipation and low bone mineral density [3]. Children with CP can have low bone mineral density (BMD) because of different factors like mobility, skeletal maturity, nutritional status, use of anticonvulsants and vitamin D levels [4]. The incidence of low BMD increases with age [5]. Low BMD can result in an increase risk of fractures which in turn can have significant impact on quality of life and delay in rehabilitation of patients [6]. The incidence of fracture in patients with CP is 15.7% [7]. Comprehensive management can reduce the risk of fracture because timely start of nutritional adjustment, medication, mobility and rehabilitation can improve the bone mineral density.

Dual-energy X-Ray Absorptiometry (DXA) of spine and hip is the gold standard for monitoring BMD. The measurement of bone mineral density z-score (BMDz-score) by DXA is used as an index of bone strength and fracture risk [7].

To our knowledge, the information about BMD and factors influencing it are lacking for CP population in Pakistan. The aim of this study is to emphasize the importance of BMD measurement in CP children as low BMD can predispose the children to fractures later in the life.

**SUBJECTS AND METHODS:**

A total of 82 children with CP were selected from June 2012 to June 2013 from the CP clinic of Armed Forces Institute of Rehabilitation Medicine (AFIRM) through non-probability consecutive sampling. Eligibility criteria for the study was children of 3-14 Year of age with CP. Excluded from the study were children who were athetoid or ataxic CP, children with metal implants or fixators at the lumbar spine, children with history of long term steroid use and children with family history of any bone disease. Parents/guardians were explained the procedure of the study and informed consent was obtained. Study was also approved by local ethical committee.

Detail medical history and complete examination were carried out on all the selected children. The height (Ht) and weight (wt), were measured. Body wt was measured in bare minimum clothes with the help of standard hospital digital scale; portable standiometer was used to measure height. Basal Metabolic

Index (BMI), daily calcium and caloric intake were determined. The appropriate parameters were used to assess the growth and nutritional status, on the basis of which children were classified as having either poor or good nutritional status. On the basis of pattern of involvement, children were divided into quadriplegic CP and non-quadruplegic CP.

Children who were undergoing physiotherapy session for the last six months were enrolled as “regular” while physiotherapy session less than six months was labeled as “not undergoing physiotherapy”. Children who were able to walk more than 100 feet without support, with or without assistive devices were labeled as “ambulators” while other were labeled as “non-ambulators” for this study. BMD at lumbar Spine (BMD-LS) was measured by an experienced radiographer using dual energy x-ray absorptiometry (DXA) machine (Hologic Discovery A, QDR series). Anteroposterior Scan of Lumbar1 to Lumbar 4 (L1-L4) vertebrae was taken for dexta imaging [8]. The system on its inbuilt database converts the BMD values into sex and age normalized z-score. A z-score of less than -2.0 was taken as low BMD [2].

#### **STATISTICAL ANALYSIS:**

Data was analyzed with the help of statistical program SPSS version 20.0. Descriptive statistics were calculated for both qualitative

and quantitative variables. Frequency and percentages were calculated for qualitative variables like gender and pattern of CP. Mean and standard deviations were calculated for quantitative variable like age and BMDz-score. Independent sample t-test was used to see the statistical significance. P-value <0.05 was used as level of significance.

#### **RESULTS:**

The demographic characteristics of the children with CP are presented in Table 1. Out of total 82 cerebral palsied children included in the study, 37 (45.1%) were males and 45 (54.9%) were females. The mean age for all the children was  $5.6 \pm 2.34$  years and mean BMDz-score was  $-2.12 \pm 0.67$ . When the children's BMD values were assessed with respect to their age group, gender, pattern of involvement, ambulation, nutritional status and physical therapy programme as shown in Table 1, there were statistically significant differences between the children in the 3 to 7 years age group compared to those in the 7 - 14 years age group, between the quadriplegic and the non quadriplegic, and children who were ambulant versus non- ambulant ( $p < 0.05$ ).

There were no statistically significant differences between the males and females, those who had and had not taken regular physical therapy programme and those who had good nutritional status versus poor nutritional status ( $p > 0.05$ ).

**Table 1:** Demographic characteristics of cerebral palsy children and comparison of their bone mineral density (BMD) z-scores

Characteristics		N (%)	BMDz-score	p-value*
Age groups	3 to 7 years	56 (68.3)	-1.94 ± 0.58	<0.05
	7 - 14 years	26 (31.7)	-2.50 ± 0.68	
Gender	Male	37 (45.1)	-2.11 ± 0.63	>0.05
	Female	45 (54.9)	-2.12 ± 0.70	
Pattern of involvement	Non-quadruplegic	57 (69.5)	1.82 ± 0.51	<0.05
	Quadruplegic	25 (30.5)	-2.80 ± 0.42	
Ambulation status	Ambulant	37 (45.1)	-1.82 ± 0.48	<0.05
	Non-ambulant	45 (54.9)	-2.36 ± 0.69	
Nutritional Status	Poor	14 (17.1)	-1.91 ± 0.45	>0.05
	Good	68 (82.9)	-2.16 ± 0.69	
Physical Therapy	Regular	44 (53.7)	-1.99 ± 0.57	>0.05
	Not at all	38 (46.3)	-2.26 ± 0.74	

\*p-value of <0.05 is significant

## DISCUSSION:

Children with CP are a diverse group of population, and there are multiple factors affecting their skeletal growth and maturation. Evaluating the factors that can delay bone development, augment bone loss, distort bone status and hence increasing fracture incidence, and then rectifying that factor to reducing fracture incidence is critical to ensuring optimal quality of life for these young people [6]. As predilection to develop pathological fractures is high amongst children with CP [9], we aimed to evaluate the bone mineral density (BMD) in these patients with cerebral palsy and to highlight factors that may affect the BMD. Factors may include immobilization, poor nutritional status, type of involvement and

anticonvulsant use [10]. Studies have shown that children with CP had significantly low BMD [11-13]. In our study BMD at lumber spine was also low. Different studies have shown that the values of BMD in ambulant CP children are significantly higher than nonambulatory CP children [14]. One other study also showed increase values of BMD with ambulation [15]. Results from another study revealed that ambulation status has no significant effect on the BMD [13]. In our study there was significant difference in BMD depending on the ambulatory status with mean BMD of ambulatory CP children was  $-1.82 \pm 0.48$  as compared to non ambulatory CP children having BMD of  $-2.36 \pm 0.69$  ( $p < 0.05$ ).

Regular Physiotherapy (PT) has no significant effect on the BMD of children with CP [12]. In our study there was also no significant effect of regular physiotherapy on the

BMD of children with CP. Nutritional status can also influence growth and bone maturation in these children [16]. In our study nutrition has no significant effect on BMD. Henderson et al. in their study reported low value of BMD in quadriplegic as compared to hemiplegic and diplegic [11]. One other study has also found significantly low BMD in quadriplegic as compared to non quadriplegic children [13]. We in our study also found significantly low BMD values of  $-2.80 \pm 0.42$  in quadriplegic CP children as compared to BMDz-score value of  $-1.82 \pm 0.51$  in nonquadriplegic CP children ( $p < 0.05$ ).

Our results demonstrate that CP children have lower BMDz-score. Furthermore, factors like the pattern of involvement & ambulation status had significant effect on BMD value in Children with CP where as Gender, nutritional status and Physiotherapy program had no significant effect on BMD value in children with CP.

**Conflict of Interest:** Nil

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