NERIMAN TSINTSADZE [1,2,3,4], ANANO VERDZADZE [1], NAZIBROLA TSIVADZE [1,3], PRAGATI CHHIKARA [1], JAYKUMAR JAKASANIYA [1], NATO KAKABADZE [3], MIKHEIL ARTMELADZE [3,4], INNA MAKHARADZE [5]

PROBLEMS OF BONE MINERAL DENSITY IN THE PEDIATRIC POPULATION OF ADJARA REGION

[1]Batumi Shota Rustaveli State University, Batumi, Georgia; [2]JSC Seamen's Medical Centre-2010, Batumi, Georgia; [3]"SoloMed" Clinic, Batumi, Georgia; [4]Avicenna – Batumi Medical University, Batumi, Georgia; [5]Moscow Sechenov Medical University, Moscow, Russia

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ნერიმან ცინცაძე [1,2,3,4], ანანო ვერძაძე [1], ნაზიბროლა ცივაძე [1,3], პრაგატი ჩიკარა [1], ჯეიკუმარ ჯაკასანია [1], ნატო კაკაბაძე [3], მიხეილ ართმელაძე [3,4], ინნა მახარაძე [5]

ძვლის მინერალური სიმკვრივის პრობლემები აჭარის რეგიონის პედიატრიულ პოპულაციაში

[1]ბათუმის შოთა რუსთაველის სახელობის სახელმწიფო უნივერსიტეტი, ბათუმი, საქართველო; [2]ს.ს. მეზღვაურთა სამედიცინო ცენტრი-2010, ბათუმი, საქართველო; [3]კლინიკა ,,სოლომედი", ბათუმი, საქართველო; [4]ავიცენა - ბათუმის სამედიცინო უნივერსიტეტი, ბათუმი, საქართველო; [5]მოსკოვის სეჩენოვის სახელობის სამედიცინო უნივერსიტეტი, მოსკოვი, რუსეთი

რეზიუმე

სიკვდილიანობის დაბალი მაჩვენებლის მიუხედავად, პედიატრიულ მოსახლეობაში ძვლის დაბალ სიმკვრივეს აქვს მნიშვნელოვანი ავადობის მაჩვენებელი. პედიატრიული მოსახლეობის 30%-ს აწუხებს მოტეხილობები, ერთ-ერთ მთავარ რისკ-ფაქტორს კი ძვლის დაბალი სიმკვრივე წარმოადგენს. კლინიკური პრაქტიკის დროს ყურადღება გავამახვილეთ პედიატრიულ პოპულაციაში ოსტეოპენიის არსებობაზე. გადავწყვიტეთ გამოგვეკვლია ძვლის სიმკვრივის ინდექსი ულტრაბგერითი დენსიტომეტრიით აჭარის რეგიონის ბავშვებში. კვლევა ჩატარდა ს.ს. "მეზღვაურთა სამედიცინო ცენტრში - 2010" ბათუმი, აჭარა, საქართველო, 2020-2023 წლებში ძვლის ულტრაბგერითი დენსიტომეტრი Sonost 2000-ის გამოყენებით. ამ კვლევაში ჩართული იყო 18 წელზე ნაკლები ასაკის 155 მონაწილე, რომელთაგანაც 52.90% (n=82) იყო გოგო, ხოლო 47,10% (n=73) იყო ბიჭი. მათ შორის 94,83%-მა (n=147) აჩვენა ძვლის სიმკვრივის ინდექსი ნორმაზე დაბალი (დაბალი, დეფიციტური, კრიტიკული), ხოლო მათგან 67%-ს (n=98) ჰქონდა დეფიციტი რძის პროდუქტების ყოველდღიურ მოხმარებაში. ჩვენი კვლევის მიხედვით, აჭარის რეგიონში ბავშვების 94.83%-ს (n=147) ჰქონდა ძვლის დაბალი სიმკვრივის ინდექსი. აღსანიშნავია, რომ გოგონებში ძვლის სიმკვრივე უფრო გამოხატულად იყო შემცირებული. ეს შედეგები ხაზს უსვამს ბავშვებში და მოზარდებში ძვლის იდეალური სიმკვრივის მონიტორინგისა და ხელშეწყობის მნიშვნელობას, ასევე ადრეული ინტერვენციების აუცილებლობას, რათა შემცირდეს ოსტეოპოროზის განვითარების შანსი ზრდასრულობაში. სავარაუდოა კავშირი ძვლის დაბალ სიმკვრივესა და რძის პროდუქტების შემცირებულ მოხმარებასთან.

INTRODUCTION. The prevalence of osteoporosis in children has been increasingly recognized in the last several decades. Even while osteoporosis in children is linked to a low mortality rate, it does carry a substantial morbidity burden [1]. Bone matrix mineralization takes place during puberty, and therefore peak bone mass is reached at the end of this growth phase. If this peak is not optimal, it will manifest the development of osteoporosis in adulthood [18]. Thirty percent of pediatric population suffers fractures. One of the main risk factors is low bone mass [30]. Studies have also shown increasing time trends for fracture incidence in children: in Sweden with a higher incidence 2007 than 1998, in Japan with a higher incidence in 1999–2007 than 1979–1987, and in Australia with a higher incidence in 2015

than 2005 [30]. The above-mentioned epidemiological data emphasize the necessity of bone density research in the pediatric population. It is crucial to identify the causes of low bone density in children in order to reduce the risk of fractures and osteoporosis in adulthood. According to the World Health Organization's (WHO) definition, osteoporosis is defined as a "systemic skeletal disease characterized by low bone mass and micro-architectural deterioration of bone tissue, with a consequent increase in bone fragility and susceptibility to fractures" [2]. Osteopenia is a term frequently conflated with osteoporosis. Osteopenia is defined as a decrease in the amount of bone tissue, and osteoporosis is osteopenia with bone fragility [3]. On the other hand, osteopenia should not be confused with osteomalacia (reduction in bone mineral with the accumulation of unmineralized bone matrix) [3]. To distinguish between children who suffer fractures as a result of typical childhood play and sports activities and those who have an underlying skeletal condition that causes bone fragility, the ISCD (International Society for Clinical Densitometry) Pediatric Positions Task Forces have worked toward definitions for pediatric osteoporosis [4]. The three components of bone strength are bone mass, bone size, and bone quality. During the two years on either side of pubertal peak growth velocity, 25% of peak bone mass is gained. Microarchitecture, bone turnover, and mineralization all affect bone quality [5]. One of the most important factors in predicting and determining the onset of osteoporosis in adulthood is reaching peak bone mass in youth. Studies suggest that 60% of the risk of osteoporosis can be attributed to the quantity of bone minerals acquired during early adulthood [2,6]. There is still uncertainty regarding the occurrence of pediatric osteoporosis, which may be related to variability in previous diagnostic standards, the lack of well-established DXA reference data in the past, and the wide range of variables that cause osteoporosis to develop.

Certain medication use, chronic illnesses, and several genetic disorders may also be linked to increased risks of fractures and low bone mineral density [7]. Considering the most recent declaration made by The Bone and Joint Decade, "worldwide, musculoskeletal conditions (including osteoporosis) are the most common causes of severe long-term pain and physical disability". Therefore, osteoporosis prevention is the better strategy to decrease fracture risk and physical disability later in life [8]. Densitometric criteria alone should not be used to diagnose osteoporosis in children and adolescents [9].

RISK FACTORS. The negative effects of glucocorticoids on bone formation may be especially vulnerable to the developing skeleton, potentially jeopardizing the accrual of cortical and trabecular bone. When glucocorticoid medication is administered, osteoblasts are affected through a variety of mechanisms, which results in significant reductions in the formation of new bone. Furthermore, independent of bone mineral density (BMD), glucocorticoid therapy modifies the microarchitecture of bone, affecting its quality and raising the risk of fractures [10,11]. Children with idiopathic juvenile osteoporosis, a rare bone disease that affects them before puberty, have abnormalities in both cortical and cancellous bone. It may occur in primary genetic conditions like Osteogenesis Imperfecta, Bruck syndrome, Osteoporosis Pseudoglioma Syndrome, Ehlers-Danlos syndrome, Marfan syndrome, and homocystinuria that affect the skeleton or connective tissue. It may also be secondary to conditions such as prolonged immobilization, glucocorticoid therapy, and chronic inflammation [12]. Increased bone resorption and turnover result from intestinal calcium absorption being restricted by insufficient vitamin D availability. Thus, nutritional factors must play a part in the development of bone mass during infancy and adolescence. Hence, a positive correlation exists between vitamin D intake and peak bone mass, with suggestions even indicating its potential impact on the development of the fetal skeleton [13]. Identifying the appropriate vitamin D dosage and achieving the essential 25-OHD level may offer benefits in treating these children. Yet, it remains uncertain whether vitamin D supplements can reliably reduce fracture rates

and enhance bone density in pediatric cases [14]. According to recent research, hypoxia inhibits osteoblast growth and strongly stimulates osteoclasts, which causes bone thinning and ultimately osteoporosis. This suggests that Obstructive Sleep Apnea Syndrome (OSAS) may be a contributing factor to osteoporosis. Acidosis due to decreased vascular perfusion may result from oxidative stress induced by the recurrent cycles of hypoxia and reoxygenation seen in OSAS. The most common type of sleep-disordered breathing, affecting 2-4% of children, is OSAS [15]. It has recently been discovered that the gene encoding the low-density lipoprotein-receptor-related protein 5 (LRP5) influences the accrual of bone mass during growth and is linked to osteoporosis, pseudoglioma syndrome, and a high bone mass phenotype. It is important to note that osteogenesis imperfecta, which is characterized by increased bone fragility, is known to be caused by mutations in the type I collagen genes (COL1A1 and COL1A2) [16].

CLINICAL SIGNS AND LABORATORY WORKUP. A thorough medical history is crucial when evaluating a child who may have osteoporosis [17]. Specific laboratory studies to assess bone mineralization should be carried out for each child. Blood tests measuring serum levels of calcium, phosphorus, creatinine, tubular phosphorus reabsorption, and sodium, along with urinary assessments of calcium, phosphorus, creatinine, urea, glucose, 25-hydroxyvitamin D3, PTH (parathyroid hormone), TSH (thyroid-stimulating hormone), and free T4, are instrumental in excluding disorders related to bone hypomineralization, such as various forms of rickets/osteomalacia. However, it is important to note that, at present, there is no blood test specifically designed to conclusively diagnose or rule out osteoporosis, except through molecular genetic testing [17,18]. In primary osteoporosis, patients typically display normal serum levels of parathyroid hormone (PTH), calcium, and phosphate. Conversely, secondary osteoporosis may manifest variations in these parameters [19]. Lastly, when examining a child with a background of injuries, fractures during infancy, or fractures that do not align with the reported history, it is essential to always consider the potential for physical abuse [20].

BONE MINERAL DENSITY (BMD) ASSESSMENT. There are several noninvasive densitometric techniques, such as dual-energy X-ray absorptiometry (DXA), magnetic resonance imaging (MRI), and quantitative computed tomography (CT), that are used to monitor bone health. Since DXA is quick, accurate, and has access to reliable pediatric reference data, it is currently considered the method of choice for assessing bone mineral density (BMD) in children and adolescents [21]. Unfortunately, obtaining and interpreting DXA results for children in their developmental stages is more intricate than for adults. Neglecting the challenges in pediatric densitometry could lead to inaccurate diagnoses and potentially unnecessary treatments [22]. In children with short stature or delayed puberty, DXA measurements typically underestimate bone mineral density (BMD, g/cm2). At present, there is no known effective method to adjust for growth delay when interpreting DXA results in children under the age of 5 [23]. The Z score is more efficient since it shows the standard deviation (SD score) concerning people of the same age [24].

OTHER MODALITIES.

Peripheral quantitative computed tomography. Utilizing specialized CT scanners, one can assess bone morphology, volumetric density, and three-dimensional images at peripheral locations with less radiation exposure. However, Quantitative CT is not the recommended option for use in children [25].

Magnetic resonance imaging (MRI). MRI has comparable advantages to quantitative ultrasound (US) in that it doesn't require ionizing radiation. However, MRI is not as suitable for a child-friendly

setting due to its limitations, which include long scanning times (up to 10–20 minutes), the need for specialized coils, and the scanner room's noisy, isolated nature from parents and caregivers [25,26].

Conventional radiography. It is widely accepted that vertebral fractures (VF) are important in identifying osteoporosis in children. It is advised that DXA be used instead of traditional radiographs when diagnosing vertebral fractures (VF), utilizing conventional radiographs [27].

Ultrasound and Bone Densitometry. Quantitative ultrasound (QUS) is a promising method for assessing both the quantity and quality of bone tissue structure. Its non-invasive nature and rapid imaging make QUS a practical choice for investigating bone changes in different clinical conditions. Exploring the potential application of QUS for screening purposes and as supplementary information to dual-energy X-ray absorptiometry (DXA) results is of significant interest. Bone densitometry is a widely accepted and frequently used tool to evaluate bone mass in adults. Recently, there has been an increasing interest in extending the use of bone densitometry to pediatrics. This interest is primarily driven by the introduction of new therapeutic approaches aimed at enhancing and maintaining bone mass in children with various conditions affecting bone growth and development [28,29].

MATERIAL AND METHODS. We investigated 155 children aged 4-18 years, by using Ultrasound Bone densitometer Sonost 2000. The subjects were categorized into two distinct groups based on gender (female - 82 children, male - 73 children) and age (4-8 years old - 73 children, 9-13 years old - 43 children, 14-18 years old - 39 children). The research was conducted at JSC „Seamen's Medical Centre – 2010" Batumi, Georgia from 2020 to 2023. They were also asked about using enough dairy products (by requirements of their daily recommended allowance).

RESULTS. The results of the examination revealed that 4.51% (n=7) exhibited a normal bone density index, 46.45% (n=72) displayed a low bone density index, 42.58% (n=66) demonstrated a deficient bone density index, and 5.81% (n=9) presented a critical bone density index. Notably, the reduction in bone density was more pronounced in girls compared to boys. Further breakdown by gender showed among the examined girls, the bone density index fell within the normal range for 4.95 % (n=4), exhibited a low bone density index for 40.24% (n=33), showed deficiency in bone density for 47.50% (n=39), and had a critical bone density index for 7.31% (n=6).

Conversely, among the examined boys, the bone density index was within the normal range for 4.16 % (n=3), showed a low bone density index for 54.16% (n=39), demonstrated deficiency in bone density for 37.50 % (n=27), and had a critical bone density index for 4.16% (n=3). 94.83% (n=147) of children in Adjara region had a bone density index below normal. Among the children examined by interviewing 67% (n=98) were found to have a deficiency in the consumption of daily dairy products (Table.1.a,Table.1.b).

Table.1.a. Data of Bone Density Z Scores (High, Good, Normal) in Children (<18 years) by Different Age Groups

Age	Total	Girls		Boys		Z ≥ 2 HIgh						2 > Z > 1 Good						1 ≥ Z ≥ 0 Normal					
						Total		Girls		Boys		Total		Girls		Boys		Total		Girls		Boys	
		N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
4-8	73	33	45.21	40	54.79	1	1.37	1	1.37	-		-		-		-		4	5.48	1	1.37	3	4.11
9-13	43	24	55.81	19	44.19	-	-	-	-	-		1	2.33	1	2.33	-		-	-	-	-	-	-
14-18	39	25	64.10	14	35.90	1	2.56	1	2.56	-		-	-	-	-	-		-	-	-	-	-	-
Total	155	82	52.90	73	47.10	2	1.29	2	1.29	-		1	0.65	1	0.65	-		4	2.58	1	0.65	3	1.94

Table.1.b. Data of Bone Density Z Scores (Low, Deficient, Critical) in Children (<18 years) by Different Age Groups

Age	Total	Girls		Boys		0 > Z ≥ 1 Low					
						Total		Girls		Boys	
		N	%	N	%	N	%	N	%	N	%
4-8	73	33	45.21	40	54.79	37	50.68	16	21.92	21	28.77
9-13	43	24	55.81	19	44.19	19	44.19	9	20.93	10	23.26
14-18	39	25	64.10	14	35.90	16	41.03	8	20.51	8	20.51
Total	155	82	52.90	73	47.10	72	46.45	33	21.29	39	25.16
Age	**Total**	**Girls**		**Boys**		**-1 > Z > -2 Deficient**					
						Total		Girls		Boys	
		N	%	N	%	N	%	N	%	N	%
4-8	73	33	45.21	40	54.79	30	41.10	15	20.55	15	20.55
9-13	43	24	55.81	19	44.19	19	44.19	12	27.91	7	16.28
14-18	39	25	64.10	14	35.90	17	43.59	12	30.77	5	12.82
Total	155	82	52.90	73	47.10	66	42.58	39	25.16	27	17.42
Age	**Total**	**Girls**		**Boys**		**-2 ≥ Z Critical**					
						Total		Girls		Boys	
		N	%	N	%	N	%	N	%	N	%
4-8	73	33	45.21	40	54.79	1	1.37	1	1.37	-	-
9-13	43	24	55.81	19	44.19	3	6.98	1	2.33	2	4.65
14-18	39	25	64.10	14	35.90	5	12.82	4	10.26	1	2.56
Total	155	82	52.90	73	47.10	9	5.81	6	3.87	3	1.94

CONCLUSION. The study emphasized the significance of bone health in children across different age groups. We divided all of our 155 children (82 were girls and 73 were boys) into 3 groups based on age (4-8; 9-13; 14-18). The findings of our study show high prevalence of children with deficient (Z Score: -1>Z>-2) bone density 42.58% (n=66), among them 59.09% (n=39) were girls and 40.91% (n=27) were boys. Study found in low, deficient and critical subgroups combined girls to boys ratio 1.13:1 (Table 2.) Our research unveiled a significant prevalence 94.83% (n=147) of osteopenia among children in Adjara region. In the examination of 147 children, it was found that approximately 67% (n=98) had a deficiency in the daily consumption of dairy products. Consequently, close monitoring during childhood and adolescence is imperative for assessing and promoting optimal bone mass.

Table 2. Osteopenia in Children (<18 years) by Different Age Groups in Adjara Region

Age	Total	Bone Density Z Scores Below Normal (Low, Deficient, Critical)			
		Girls		Boys	
		N	%	N	%
4-8	73	32	43.8	36	49.3
9-13	43	22	51.2	19	44.2
14-18	39	24	61.5	14	35.9
Total	155	78	50.3	69	44.5

RECOMMENDATIONS. The low bone density detected in 94.83% of 155 children aged 4 to 18 years of Adjara made it necessary to submit information about the prevalence of low bone density in the same population to the health care institutions of the region. It is imperative that health care organizations in the region take action, conduct additional research, and ensure the elimination and prevention of low bone density in the pediatric population.

REFERENCES:

1. Y. Uziel, E. Zifman, P. J. Hashkes, "Osteoporosis in children: Pediatric and pediatric rheumatology perspective: A review," *Pediatric Rheumatology*, 2009 Oct 16; 7:16. doi: 10.1186/1546-0096-7-16.
2. C. M. Laine and T. Laine, "Diagnosis of osteoporosis in children and adolescents," *Eur Endocrinol*, vol. 9, no. 2, pp. 141–144, 2013, doi: 10.17925/ee.2013.09.02.141.
3. K. I. Khoshhal and F. Ed, "Childhood Osteoporosis."
4. L. M. Ward, D. R. Weber, C. F. Munns, W. Högler, and B. S. Zemel, "A contemporary view of the definition and diagnosis of osteoporosis in children and adolescents," *Journal of Clinical Endocrinology and Metabolism*, vol. 105, no. 5. Endocrine Society, May 01, 2020. doi: 10.1210/clinem/dgz294.
5. A. T. Titmuss, A. Biggin, S. Korula, and C. F. Munns, "Diagnosis and Management of Osteoporosis in Children," *Curr Pediatr Rep*, vol. 3, no. 2, pp. 187–199, Jun. 2015, doi: 10.1007/s40124-015-0082-z.
6. A. D. G. Baxter-Jones, R. A. Faulkner, M. R. Forwood, R. L. Mirwald, and D. A. Bailey, "Bone mineral accrual from 8 to 30 years of age: An estimation of peak bone mass," *Journal of Bone and Mineral Research*, vol. 26, no. 8, pp. 1729–1739, Aug. 2011, doi: 10.1002/jbmr.412.
7. K. Gipson, M. Lu, and T. B. Kinane, "Sleep-disordered breathing in children," *Pediatr Rev*, vol. 40, no. 1, pp. 3–12, Jan. 2019, doi: 10.1542/pir.2018-0142.
8. G. Saggese, G. I. Baroncelli, S. Bertelloni, and G. I. Baroncelli Endocrine, "Osteoporosis in Children and Adolescents: Diagnosis, Risk Factors, and Prevention," 2001.
9. F. Rauch *et al.*, "Fracture Prediction and the Definition of Osteoporosis in Children and Adolescents: The ISCD 2007 Pediatric Official Positions," *Journal of Clinical Densitometry*, vol. 11, no. 1, pp. 22–28, Jan. 2008, doi: 10.1016/j.jocd.2007.12.003.
10. M. B. Leonard, "Glucocorticoid-induced osteoporosis in children: Impact of the underlying disease," in *Pediatrics*, Mar. 2007. doi: 10.1542/peds.2006-2023J.
11. I. L. Engvall, B. Svensson, B. Tengstrand, K. Brismar, and I. Hafström, "Impact of low-dose prednisolone on bone synthesis and resorption in early rheumatoid arthritis: Experiences from a two-year randomized study," *Arthritis Res Ther*, vol. 10, no. 6, Nov. 2008, doi: 10.1186/ar2542.
12. J. Bacchetta, K. Wesseling-Perry, et al. "Idiopathic juvenile osteoporosis: a cross-sectional single-centre experience with bone histomorphometry and quantitative computed tomography," 2013. [Online]. Available: http://www.ped-rheum.com/content/11/1/6
13. S. Docio et al. Seasonal Deficiency of Vitamin D in Children: A Potential Target for Osteoporosis-Preventing Strategies? 1998.
14. S. A. Bowden, R. F. Robinson, R. Carr, and J. D. Mahan, "Prevalence of vitamin D deficiency and insufficiency in children with osteopenia or osteoporosis referred to a pediatric metabolic bone clinic," *Pediatrics*, vol. 121, no. 6, Jun. 2008, doi: 10.1542/peds.2007-2111.
15. N. S. Sies et al., "Obstructive sleep apnoea syndrome (OSAS) as a risk factor for secondary osteoporosis in children," *Sci Rep*, vol. 11, no.1, Dec. 2021, doi: 10.1038/s41598-021-82605-6.
16. H. Hartikka et al., "Heterozygous mutations in the LDL receptor-related protein 5 (LRP5) gene are associated with primary osteoporosis in children," *Journal of Bone and Mineral Research*, vol. 20, no. 5, pp. 783–789, May 2005, doi: 10.1359/JBMR.050101.
17. S. Ciancia et al., "Osteoporosis in children and adolescents: when to suspect and how to diagnose it," *European Journal of Pediatrics*, vol. 181, no. 7. Springer Science and Business Media Deutschland GmbH, pp. 2549–2561, Jul. 01, 2022. doi: 10.1007/s00431-022-04455-2.
18. Galindo-Zavala R, Bou-Torrent R, Magallares-López B, Mir-Perelló C, Palmou-Fontana N, Sevilla-Pérez B, Medrano-San Ildefonso M, González-Fernández MI, Román-Pascual A, Alcañiz-Rodríguez P, Nieto-Gonzalez JC, López-Corbeto M, Graña-Gil J. Expert panel consensus recommendations for

diagnosis and treatment of secondary osteoporosis in children. Pediatr Rheumatol Online J. 2020 Feb 24;18(1):20. doi: 10.1186/s12969-020-0411-9. PMID: 32093703; PMCID: PMC7041118.
19. M. P. Jeremiah, B. K. Unwin, and M. H. Greenawald, "Diagnosis and Management of Osteoporosis," 2015. [Online]. Available: www.aafp.org/afp
20. A. M. Boyce and R. I. Gafni, "Approach to the child with fractures," *Journal of Clinical Endocrinology and Metabolism*, vol. 96, no. 7, pp. 1943–1952, Jul. 2011, doi: 10.1210/jc.2010-2546.
21. K. H. Chong, B. K. Poh, N. A. Jamil, N. A. Kamaruddin, and P. Deurenberg, "Radial quantitative ultrasound and dual energy X-ray absorptiometry: Intermethod agreement for bone status assessment in children," *Biomed Res Int*, vol. 2015, 2015, doi: 10.1155/2015/232876.
22. L. K. Bachrach, "Osteoporosis in children: Still a diagnostic challenge," *Journal of Clinical Endocrinology and Metabolism*, vol. 92, no. 6. Endocrine Society, pp. 2030–2032, 2007. doi: 10.1210/jc.2007-0828.
23. J. Kocks, K. Ward, Z. Mughal, R. Moncayo, J. Adams, and W. Högler, "Z-score comparability of bone mineral density reference databases for children," *Journal of Clinical Endocrinology and Metabolism*, vol. 95, no. 10, pp. 4652–4659, 2010, doi: 10.1210/jc.2010-0677.
24. R. I. Gafni and J. Baron, "Overdiagnosis of osteoporosis in children due to misinterpretation of Dual-energy x-ray absorptiometry (DEXA)," *Journal of Pediatrics*, vol. 144, no. 2, pp. 253–257, Feb. 2004, doi: 10.1016/j.jpeds.2003.08.054.
25. F. F. Alqahtani and A. C. Offiah, "Diagnosis of osteoporotic vertebral fractures in children," *Pediatric Radiology*, vol. 49, no.3. Springer Verlag, pp 283–296, Mar 07, 2019. doi: 10.1007/s00247-018-4279-5.
26. A. J. Sawyer et al., "Chapter 2 / Measuring Bone in Children and Adolescents 15 15 2 From: Current Clinical Practice: Bone Densitometry in Growing Patients: Guidelines for Clinical Practice c c Edited Tools for Measuring Bone in Children and Adolescents."
27. E. Adiotomre et al., "Diagnostic accuracy of DXA compared to conventional spine radiographs for the detection of vertebral fractures in children," *EurRadiol*, vol. 27, no. 5, pp. 2188–2199, May 2017, doi: 10.1007/s00330-016-4556-3.
28. P. Adamczyk, M. Szczepanska, and W. Pluskiewicz, "Skeletal status assessment by quantitative ultrasound and bone densitometry in children with different renal conditions," *Osteoporosis International*, vol. 29, no. 12, pp. 2667–2675, Dec. 2018, doi: 10.1007/s00198-018-4659-6.
29. R. R. van Rijn et al., "Bone densitometry in children: A critical appraisal," *European Radiology*, vol. 13, no. 4. Springer Verlag, pp. 700–710, Apr. 01, 2003. doi: 10.1007/s00330-002-1676-8.
30. Rosengren BE, Bergman E, Karlsson J, Ahlborg H, Jehpsson L, Karlsson MK. Downturn in Childhood Bone Mass: A Cross-Sectional Study Over Four Decades. JBMR Plus. 2021 Nov 26;6(1):e10564. doi: 10.1002/jbm4.10564. PMID: 35079676; PMCID: PMC8770995.

NERIMAN TSINTSADZE [1,2,3,4], ANANO VERDZADZE [1], NAZIBROLA TSIVADZE [1,3], PRAGATI CHHIKARA [1], JAYKUMAR JAKASANIYA [1], NATO KAKABADZE [3], MIKHEIL ARTMELADZE [3,4], INNA MAKHARADZE [5]

PROBLEMS OF BONE MINERAL DENSITY IN THE PEDIATRIC POPULATION OF ADJARA REGION

[1]Batumi Shota Rustaveli State University, Batumi, Georgia; [2]JSC Seamen's Medical Centre – 2010, Batumi, Georgia; [3]"SoloMed" Clinic, Batumi, Georgia; [4]Avicenna – Batumi Medical University, Batumi, Georgia; [5]Moscow Sechenov Medical University, Moscow, Russia

SUMMARY

Background: Despite having a low mortality rate, pediatric low bone density has a significant morbidity burden. During pubertal peak growth velocity, approximately 25% of peak bone mass is accumulated. If this peak is not optimal, it will manifest the development of osteoporosis in adulthood. Thirty percent of pediatric population suffers fractures. One of the main risk factors is low bone mass.

Objectives: During clinical practice, attention was paid to the fact that osteopenia was observed in the pediatric population. We decided to investigate the bone density index using ultrasound densitometry in children of Adjara Region. Also, up to date statistical data was not found in reliable scientific sources, which fueled our desire to be more interested in the prevalence of low bone density in pediatric population.

Methods: Research was conducted at JSC "Seamen's Medical Centre – 2010" Batumi, Adjara, Georgia between 2020 to 2023 by utilizing an Ultrasound Bone Densitometer Sonost 2000.

Results: Among the 155 evaluated participants included in this study were aged less than 18 years, 52.90% (n=82) were girls, and 47,10% (n=73) were boys. Among them, 94.83% (n=147) demonstrated a bone density index below Normal (Low, Deficient, Critical), and 67% (n=98) of them had a deficiency in the daily consumption of dairy products.

Conclusion: According to our research, 94.83% (n=147) of children in Adjara region had a low bone density index. Notably, girls exhibited a more pronounced reduction in bone density. These results highlight the significance of monitoring and promoting the ideal bone mass in children and adolescents, also the necessity of early interventions to reduce the chance of osteoporosis in later life. There is a probable association with the reduced consumption of dairy products.

Keywords: Bone Mineral Density, Osteoporosis, Z score.