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Frequency of Hypocalcemia in Children Aged Less Than Two Years Presenting with First Afebrile Seizure

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ABSTRACT

Background: Afebrile seizures in small children are a frequent reason for hospital visits, and the exact cause is not always obvious at the time of presentation. In many cases, metabolic problems may contribute, and low calcium levels are one of the issues that can trigger seizures. This is particularly relevant in settings where nutritional intake is often inadequate and children may be more prone to deficiencies. Knowing how often hypocalcemia is present in young children with their first afebrile seizure can help clinicians decide which investigations are necessary and which treatments should be given early. **Methodology:** This descriptive cross-sectional study was carried out in the Department of Pediatrics at Hayatabad Medical Complex, Peshawar for the duration of six months, from August 2024 to January 2025. A total of 130 children between 2 and 24 months of age who presented with their first afebrile seizure were included through consecutive sampling after obtaining ethical approval. Clinical information was recorded, and a venous blood sample (2 mL) was taken to check serum calcium. Hypocalcemia was defined as a calcium level below 8 mg/dL. Data were entered and analyzed using SPSS version 22. Quantitative variables were summarized as mean and standard deviation, while categorical variables were presented as frequencies and percentages. Chi-square or Fisher's exact test was used where appropriate, with a p-value of 0.05 taken as significant. **Results:** A high proportion of the children, about 68.5%, were found to have hypocalcemia. The trend was more noticeable in younger infants and those belonging to lower socioeconomic households. Children who had seizures lasting longer than a few minutes also showed a greater likelihood of having low calcium levels. Although not all associations reached statistical significance, the overall pattern suggested that calcium deficiency may play an important role in the presentation of afebrile seizures in this age group. **Conclusion:** The study shows that hypocalcemia is quite common among children under two years who come with a first episode of afebrile seizure. Checking serum calcium at the time of presentation may help in early management, reduce the duration or severity of seizures, and prevent unnecessary investigations, particularly in hospitals where resources are limited.

INTRODUCTION

Seizures in young children are a common reason for emergency department (ED) visits and are often the trigger for comprehensive workup to determine their causes. A seizure can be classified into two categories, febrile and afebrile, depending on whether there is a fever or not. Depending on the seizure type, febrile seizures are more common, and they are overall benign, yet, afebrile seizures are more concerning, as they are more likely to recur and may be preceded by an underlying neurological or metabolic disturbance. As a result, children presenting to the ED with their first afebrile seizure are often the subject of a detailed search for potentially reversible causes for the seizure [1-3].

In the past years, metabolic defects have gained recognition as major triggering factors leading to seizures, particularly in infants and toddlers. Some of the biochemical disturbances are the most reported and include hypocalcemia [4-6]. Deficiency of calcium can cause neuromuscular irritability or even cause seizures that do not respond to common anticonvulsant medications. Multiple studies have documented and discussed the relevance of hypocalcemia in new-onset seizures without fever, ofmoderateto high frequency. A study in Pakistan showed more than 68% of first afebrile convulsions had hypocalcemia which raised concerns regarding the likely impact of nutritional deficiencies and low dietary calcium in lower-middle income countries [7-9].

Even with the clinical importance of this relationship, there is a shortage of local data related to hypocalcemiawithin afebrile seizures. This information gap is especially pertinent to countries like Pakistan. Issues related to nutrition, lack of access to fortified foods, and deficits in the health practices of young children are likely to elevate the risk of calcium deficiency in infants. Knowing how often bear this risk hypocalcemia would help in focusing efforts in necessary further investigations, facilitating the timely biochemical correction of deficiencies, and avoiding the need for more invasive, high costs, or complex diagnostics like neuroimaging.

The current study was therefore undertaken to determine the frequency of hypocalcemia in children under two years presenting with their first afebrile seizure at a major tertiary-care hospital. The findings aim to support more informed clinical decision-making and contribute to the body of evidence needed to refine pediatric seizure management in resource-limited environments.

METHODOLOGY

This research was framed as a descriptive cross-sectional study to identify how often hypocalcemia occurs in children younger than two years of age who presented to the ED with their first afebrile seizure.A cross-sectional design was considered appropriate because it allows assessment of the magnitude of a condition within a defined time period without manipulating exposure or outcomes. The research was carried out in the Department of Pediatrics at Hayatabad Medical Complex (HMC), Peshawar, a major tertiary-care teaching hospital that receives referrals from both urban and rural regions of Khyber Pakhtunkhwa, ensuring representation of a wide catchment population.

Before the commencement of data collection, ethical approval for the study was obtained from the Institutional Research and Ethical Board of Hayatabad Medical Complex. The study was approved under IREB Approval No. 1918, dated 10 July 2024, confirming compliance with the Declaration of Helsinki and institutional research guidelines. In addition, the College of Physicians and Surgeons Pakistan (CPSP) reviewed and approved the synopsis through its Research Evaluation Unit on 22 July 2024, under the reference CPSP/REU/PED-2023-021-7596, allowing the project to proceed formally as part of the FCPS-II dissertation requirements.

The study spanned for six months after synopsis approval; therefore, data collection began after 22 July 2024 after approval, from August 2024 to January 2025.

A sample size sample size of 130 was derived from the WHO sample estimator using a hypocalcemia rate of 68.3% from a previous report for children with seizures. 95% confidence level and 8% absolute precision were also used. 130 children were participants in this study and were children with seizure from the pediatric inpatient unit. 130 cases were validated through non-probability consecutive sampling. In this sampling technique every eligible child within the data collection. were approached until the sample size was reached. This sampling technique has ensured adequacy and has reduced the time to choose a sample in a busy arrangement.

The following age criteria were adhered to closely. The study sample consisted of children of either sex aged between 2 and 24 months, and presenting with their first afebrile seizure. To reduce the risks of confounding factors from the study, children with known cerebral palsy, CNS malformations, metabolic derangements including altered blood sugar, magnesium and phosphorus levels, and any primary structural abnormality of the brain were excluded from the study.

After receiving informed consent from the children's parents or guardians, who filled out the consent forms in both English and Urdu, as included in your documented submission, each child had a history and clinical examination by a physician. Relevant demographic details including and not limited to age, sex, and place of residence, vaccination history, and details regarding the family such as the father's occupation, the mother's highest education level, and the family's economic wellbeing (which are also socioeconomic factors) were also collected. Clinical data such as length of seizure episodes were also collected. All of the information was collected and organized into data collection forms created for the research.

The blood sampling process utilized an aseptic technique while drawing blood. Every child from the study had 2mL of venous blood withdrawn and this sample was sent to the hospital laboratory for the measurement of serum calcium. In the synopsis operational definition, we defined and diagnosed hypocalcemia as a serum calcium level of 8 mg/dL. During the study, the seizure episodes that the subjects had were managed according to the hospital's standard protocols and the research procedures did not disrupt the clinical care.

All data were entered into SPSS version 22.0. Quantitative variables such as age and seizure duration were summarized using mean and standard deviation. The Shapiro–Wilk test was applied to assess normality, and non-normally distributed data were presented using median and interquartile ranges. Categorical variables including gender, socioeconomic status, parental characteristics, vaccination status, and the presence or absence of hypocalcemia were presented as frequencies and percentages. To evaluate effect modification, stratification was carried out for age, gender, residence, vaccination status, seizure duration, father's profession, mother's education, and socioeconomic class. Associations between these variables and hypocalcemia were tested using the Chi-square test, with Fisher's exact test applied when expected cell counts were small. A p-value ≤ 0.05 was considered statistically significant, following the standard guidelines for biomedical research.

RESULTS

The majority of children who came in for their first afebrile seizure were, on average, 13.4 months old and in the later stages of infancy. Participants were mostly boys. This is a trend observed in the majority of pediatric emergency care. The children came equally from urban and rural areas, indicating that afebrile seizures are present in all types of communities. Most of the children had their

routine vaccinations, and a smaller number were partially vaccinated or unvaccinated.

Table 1
Baseline characteristics of children presenting with first afebrile seizure (n = 130)

Variable	Category	Frequency (n)	Percentage (%)
Age (months)	Mean ± SD	**13.4 ± 6.1**	–
Gender	Male	78	60.0
	Female	52	40.0
Residence	Urban	72	55.4
	Rural	58	44.6
Vaccination status	Fully vaccinated	96	73.8
	Partially vaccinated	22	16.9
	Not vaccinated	12	9.2

The caregivers of the enrolled children had diverse occupational and educational history. Information from about 55% of fathers employed in wage work positions. The rest were self-employed or not working. The range of maternal schooling also had great diversity in that roughly one third had no formal education. Close to half of the families were classified in the low socioeconomic status group conforming to the socioeconomic profile of the hospital's catchment area. The socio-demographic characteristics of these families help to understand the socio surrounding and caregiving conditions of the children in the research.

Table 2
Parental and socioeconomic characteristics (n = 130)

Variable	Category	Frequency (n)	Percentage (%)
Father's profession	Job	68	52.3
	Business	34	26.2
	Unemployed	28	21.5
Mother's education	Illiterate	40	30.8
	Primary	33	25.4
	Secondary	30	23.1
	Matric and above	27	20.8
Socioeconomic status	Low	62	47.7
	Middle	49	37.7
	High	19	14.6

Of the 130 children surveyed, 68.5% scored positive for hypocalcemia. Considering this portion is substantial, hypocalcemia ought not to be overlooked as a pertinent calcium deficiency-associated risk factor for afebrile seizures in the younger population. The other 31.5% of the children exhibited standard calcium values. The results of this study are a reminder to health care professionals of the clinical importance of measuring calcium levels in the serum for the immediate evaluation of these patients.

Table 3
Frequency of hypocalcemia (n = 130)

Serum calcium status	Frequency (n)	Percentage (%)
Hypocalcemia present	89	68.5
Normal calcium level	41	31.5
Total	**130**	**100.0**

Analysis showed that younger infants were more likely to have hypocalcemia, but the data was not aligned with a pattern to be statistically significant. There were not large enough gender differences to be statistically significant. Hypocalcemia was linked to the duration of seizures as children with longer seizure episodes more often presented with hypocalcemia, indicating that a more prominent gap of calcium imbalance was also present. There were also evident hypocalcemia disparities socioeconomically as families with greater income showed a lower burden of hypocalcemia. These added to the education of mothers where the lower the education the greater the hypocalcemia. There was also a pattern hypocalcemia status with vaccination but it was not statistically significant.

Table 4
Stratification of hypocalcemia by demographic and clinical characteristics (n = 130)

Variable	Category	Hypocalcemia Yes n (%)	Hypocalcemia No n (%)	p-value
Age group	2–6 months	24 (80.0)	6 (20.0)	
	7–12 months	23 (67.6)	11 (32.4)	
	13–18 months	24 (66.7)	12 (33.3)	
	19–24 months	18 (60.0)	12 (40.0)	**0.21**
Gender	Male	57 (73.1)	21 (26.9)	
	Female	32 (61.5)	20 (38.5)	**0.18**
Seizure duration	≤5 minutes	58 (63.0)	34 (37.0)	
	>5 minutes	31 (81.6)	7 (18.4)	**0.04**
Residence	Urban	46 (63.9)	26 (36.1)	
	Rural	43 (74.1)	15 (25.9)	**0.19**
Father's profession	Job	49 (72.1)	19 (27.9)	
	Business	21 (61.8)	13 (38.2)	
	Unemployed	19 (67.9)	9 (32.1)	**0.63**
Mother's education	Illiterate	32 (80.0)	8 (20.0)	
	Primary	24 (72.7)	9 (27.3)	
	Secondary	18 (60.0)	12 (40.0)	
	Matric+	15 (55.6)	12 (44.4)	**0.07**
Socioeconomic class	Low	48 (77.4)	14 (22.6)	
	Middle	31 (63.3)	18 (36.7)	
	High	10 (52.6)	9 (47.4)	**0.03**
Vaccination status	Fully vaccinated	61 (63.5)	35 (36.5)	
	Partially vaccinated	17 (77.3)	5 (22.7)	
	Not vaccinated	11 (91.7)	1 (8.3)	**0.09**

The average serum calcium level in the population was 7.9 ± 1.11 mg/dL and the majority of the values were slightly lower than the lower level of normal calcium values in the

pediatrics. This confirms the previously noted fact that calcium deficiency is the commonest abnormality in children with afebrile seizures.

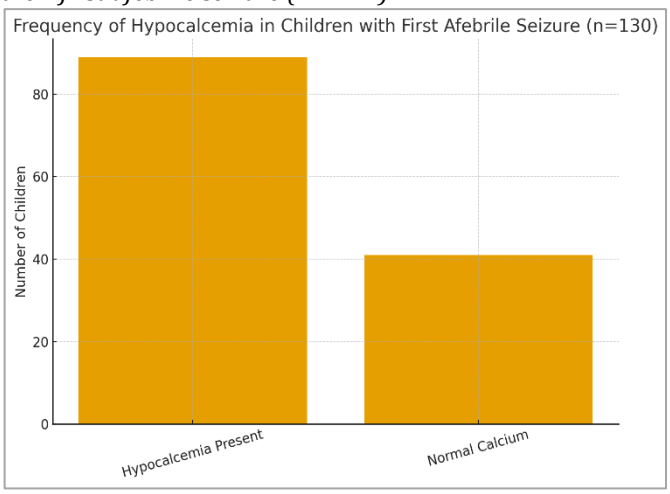
Table 5

Mean serum calcium level (n = 130)

Parameter	Mean ± SD (mg/dL)	95% CI
Serum calcium level	7.9 ± 1.1	7.7 – 8.1

Figure 1

Frequency of hypocalcemia among children presenting with their first afebrile seizure (n = 130).



The bar graph shows the distribution of serum calcium status for children in the study. Out of the total, 89 children (68.5%) were recorded as having hypocalcemia while 41 children (31.5%) had calcium levels in the normal range. The data represent the considerable hypocalcemia prevalent in this group of children which further emphasizes the need for routine biochemical assessment in children with afebrile seizures.

DISCUSSION

This study focused on the condition called hypocalcemia which is the low concentration of calcium in the blood, among children 2 years and younger who are having their first afebrile seizure. Most of the children tested in this study also had low serum calcium levels. This information is critical to discussions regarding the need for biochemical tests to explore the cause of afebrile seizures in less well-resourced countries. This study also showed that hypocalcemia among this population was indeed quite high, consistent with earlier study results documenting hypocalcemia rates among children with the same presenting complaints to be 68.3% [10, 11]. This also implies that hypocalcemia as a possible cause for afebrile seizures is likely much more prevalent than what is recognized especially in under-resourced settings characterized by poor nutritional status and low calcium dietary intake.

Younger infants, even though the pattern did not attain statistical significance, showed a greater proportion of hypocalcemia than the older children. The age-related discontinuity may represent variations in the dietary transition and feeding methods, or in the calcium regulatory mechanisms during early infancy, which are still immature. Prior research has noted these same susceptibilities in younger age groups and the potential risk of neuromuscular irritability and seizures stemming from a lack of vitamin D and calcium. Such interpretations are consistent with the daily clinical experience in overloaded pediatrc emergency departments. It is not uncommon for infants with dietary insufficiencies to present with seizures of unclear etiology [12, 13].

There was a slight prevalence of hypocalcemia within the male population, though the difference was statistically insignificant. Similar male preponderance within the patient population has been reported in other hospital-based pediatric studies focusing on seizures. Although biological variables are likely not the reason for the difference, differing sociocultural traditions regarding the decision to seek care may explain some of the disparity. These findings are situated within the larger context as noted above [14, 15].

One of their most notable findings was the relationship between the duration of seizure(s) and the level of calcium in the bloodstream. Children who have seizures that last more than 5 minutes have an increased odds of having hypocalcemia. This relationship would suggest that the low calcium level participates in the development as well as the continuation of the episode. There have been other authors who described the same pattern of hypocalcemia and other biochemical disturbances with the prolongation or repetition of seizure(s). This relationship provides an even stronger case for the biochemical investigation to be done in a timely manner in an effort to promptly correct the calcium levels and potentially limit the duration and/or refractory seizures [16, 17].

There was also an important linkage between socioeconomic status and hypocalcemia prevalence whereby children in poorer households were more likely to exhibit low calcium levels. This is similar to the low calcium levels seen in the regional health data accessed. This health data highlights the problem of malnutrition in children and the type of data public health pediatrics are usually limited to. The relationships observed also suggest educational deficits of the mothers. The children of these women without schooling in a hypocalcemic state were affected proportionally more. This quotient also has literature backing the comments made as children's health and nutritional status is often a result of the mothers positive or negative health education, feeding practices, and decision-making authority in the household [18, 19].

The research also identifies an important association between socioeconomic status and hypocalcemia, with children from economically vulnerable families being more likely to have low calcium levels. This is also evident from the low calcium levels from the accessed health data regionally. This regional health data indicate malnutrition among children and illustrate the data the field of public health pediatrics is predominantly confined to. The relations witnessed here also indicate a gap in education among the mothers. The children of these uneducated women in a hypocalcemic state are more proportionally affected and there is also literature to back this quotient for the comments made as the health and nutritional status of children is a direct resultant of the mother's health education, positive or negative, feeding practices and the mother's authority in making decisions in the family.

Taken together, the findings indicate that the hypocalcemia condition has a significant contribution to the occurrence of the first afebrile seizures event in infants and young children. Other studies conducted in Pakistan and similar low- and middle-income nations have expressed comparable worries, suggesting that basic biochemical assessments, particularly serum calcium level evaluations, could minimize superfluous neuroimaging and facilitate timely neuroimaging [20]. The results of the previous studies, along with the results of the current study, suggests that timely diagnosis and treatment of hypocalcemia can prevent prolonged seizures and, as a result, decrease emergency department overcrowding and prevent the performance of expensive imaging studies and/modifies the need to perform expensive imaging studies [20].

This understanding also aligns with the realities of pediatric units where there is a clinical experience with children with refractory/recurrent seizures where terminal hypocalcemia is identified, and seizures rapidly respond to IV calcium. However common clinical observations, they are validated to a greater extent with organized data. The understanding seen in this study illustrates an integration of clinical wisdom and selective laboratory testing that would optimize outcomes based on the clinical scenarios of seizures.

CONCLUSION

The findings highlight that hypocalcemia is a frequent biochemical abnormality among children under two years presenting with their first afebrile seizure. The high prevalence observed across different demographic and socioeconomic groups suggests that serum calcium testing should be considered a routine part of the evaluation in such cases. Associations with prolonged seizure duration, lower socioeconomic status, and limited maternal education further emphasize the multifactorial influences on calcium deficiency. These patterns carry meaningful clinical implications, especially in settings where nutritional gaps are common and access to advanced diagnostic tools is limited. Early recognition and correction of hypocalcemia may help prevent recurrent or prolonged seizures and reduce the need for unnecessary neuroimaging.

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