Journal DOI: 10.36713/epra0412 ISSN: 2277–7741

International Journal of

Asian Economic Light (JAEL) – Peer Reviewed Journal

SJIF Impact Factor (2025): 8.579 Volume: 13 | Issue: 11 | November 2025

ASSESSING THE PREVALENCE AND CONTRIBUTING FACTORS OF VITAMIN D AND CALCIUM DEFICIENCY IN PRESCHOOL – AGED CHILDREN, IN THE BIN JAWAD REGION-LIBYA 2024

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ABSTRACT

*This cross-sectional study (May–August 2024) assessed vitamin D and calcium deficiency in 50 preschool-aged children in Bin Jawad, Libya. Blood tests and maternal questionnaires revealed that 60% of children had vitamin D deficiency: 12% very severe (<10 ng/mL), 32% severe (10–20 ng/mL), and 16% moderate (21–29 ng/mL). Deficiency was slightly more common in girls (68%) than boys (52%), but the difference was **not statistically significant (p = 0.746). Deficiency rates across age groups (7–24, 25–36, and 37–60 months) were 60%, 63%, and 56%, respectively, with the oldest group showing the highest proportion of normal vitamin D levels (≥30 ng/mL).Calcium deficiency was found in 18% of boys and 8% of girls, with no significant association between vitamin D and calcium deficiency (p = 0.232). Key risk factors included inadequate sun exposure (68% had irregular exposure; 20% had none) and low breastfeeding rates (80% were not breastfed). The study recommends increased sunlight exposure, nutritional education, and supplementation programs to combat these deficiencies.*

KEYWORDS: *Vitamin D, Calcium Deficiency, Sun Exposure.*

INTRODUCTION

Nutrition is a critical factor in maintaining health, physical efficiency, longevity, creativity, and preventing disease [1, 2]. The consumption of insufficient nutrients adversely affects not only children's physical development but also their cognitive and psychosocial development [3]. Studies from various countries indicate that a significant number of children across different age groups suffer from latent or severe deficiencies of various nutrients, including proteins, fats, vitamins, and minerals.[3]

Calcium is one of the key minerals essential for numerous physiological processes in a child's body. It plays a vital role in regulating hormone secretion, muscle contraction, nerve impulse transmission, immune system function, mental performance, and bone development [4, 5]. Ensuring adequate calcium intake can prevent various disorders, minimize growth problems, prevent osteoporosis and osteopenia, and protect against future bone fractures [6]. Calcium metabolism is closely dependent on vitamin D, parathyroid hormone, and calcitonin levels. Vitamin D stimulates the intestinal absorption of calcium and phosphorus, regulates serum calcium levels, and maintains proper skeletal mineralization [7]. Consequently, insufficient intake of either calcium or vitamin D in children can lead to impaired bone mineralization and disorders of the muscular, nervous, immune, and other systems.[8]

The pediatric population has an increased requirement for vitamin D and calcium due to rapid growth and increasing bone mass during this period. Studies from various regions of the world have shown that apparently healthy pediatric populations are deficient in calcium and vitamin D, and the incidence of rickets and osteomalacia is increasing [9, 10, 11]. The high prevalence of vitamin D deficiency among young children warrants intervention for proper nutritional support [12]. Furthermore, the percentage of individuals meeting the Recommended Dietary Allowance (RDA) decreases as children reach adolescence [13]. As noted in Nelson's Textbook of Pediatrics, "The normal total serum calcium concentration in children is 8.8-10.8 mg/dL (2.20-2.70 mmol/L). Symptoms of hypocalcemia usually do not

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occur until the serum calcium concentration falls below 7-8 mg/dL (1.75-2.00 mmol/L) Severe hypercalcemia (Ca >14 mg/dL [3.5 mmol/L]) is a medical emergency.(14) "

It has been observed that requests for vitamin D and calcium deficiency tests for preschool-aged children are very frequent in medical laboratories in Bin Jawad. Recognizing the seriousness of this issue for children's growth, health, and future, we identified the necessity of conducting this research. This study aims to identify the factors contributing to vitamin D and calcium deficiency in this age group, understand the relationship between these deficiencies and variables such as age and gender, and evaluate mothers' awareness of the importance of balanced nutrition in preventing these deficiencies.

METHODOLOGY

Study Design and Setting

This cross-sectional study was carried out between May and June 2024 in the Bin Jawad region of Libya, a semi-urban coastal area with limited access to specialized pediatric care. The target population comprised children aged five years and younger who attended local health facilities.

Sampling

Using a convenience (accidental) sampling approach, we enrolled 50 child–mother pairs from five medical laboratories operating in the Bin Jawad area. These laboratories serve as primary points for pediatric blood testing in the region, making them practical sites for participant recruitment. Inclusion criteria were straightforward: children under 60 months of age whose mothers provided informed consent.

Data Collection Procedures

Data were gathered through two complementary methods: a structured maternal questionnaire and laboratory analysis of venous blood samples.

Maternal Questionnaire

Trained interviewers conducted face-to-face interviews with mothers using a pretested, structured questionnaire. The tool was designed to capture key sociodemographic and behavioral factors potentially influencing vitamin D and calcium status, including: - Child's age and sex - Household location (urban vs. rural within Bin Jawad) - Daily sun exposure patterns (duration, frequency, and use of sun protection) - History of vitamin D or calcium supplementation (for both mother and child) - Maternal knowledge regarding dietary sources and health risks associated with vitamin D and calcium deficiency. All interviews were conducted in Arabic to ensure clarity and cultural appropriateness.

Blood Sample Collection and Processing

A trained phlebotomist collected 5 mL of venous blood from each child using standard aseptic technique: the puncture site was cleaned with 70% alcohol, a tourniquet was applied, and blood was drawn into sterile, labeled biochemical tubes. Samples were transported on ice to the nearest collaborating laboratory within two hours of collection. Upon arrival, samples were centrifuged using a HAMILTON centrifuge at 4,000 rpm for 10 minutes to separate serum, which was then aliquoted and stored at –20°C until analysis.

Vitamin D Assay

Serum concentrations of 25-hydroxyvitamin D [25(OH)D]—the gold-standard biomarker for vitamin D status—were measured using a competitive protein-binding immunoassay on the Ichroma™ immunofluorescence analyzer (Boditech Inc., Republic of Korea). The assay followed the manufacturer's protocol:

Calcium Assay

Total serum calcium was quantified using a colorimetric method based on the o-cresolphthalein complexone reaction.

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Data Analysis

All data were entered and analyzed using IBM SPSS Statistics, version 22. Descriptive statistics—including frequencies, percentages, means, and standard deviations—were used to summarize participant characteristics and nutrient levels. To explore potential associations, we applied chi-square tests for categorical variables (e.g., deficiency status by gender or sun exposure) and one-way ANOVA for continuous outcomes across age groups. A p-value < 0.05 was considered statistically significant.

Ethical Considerations

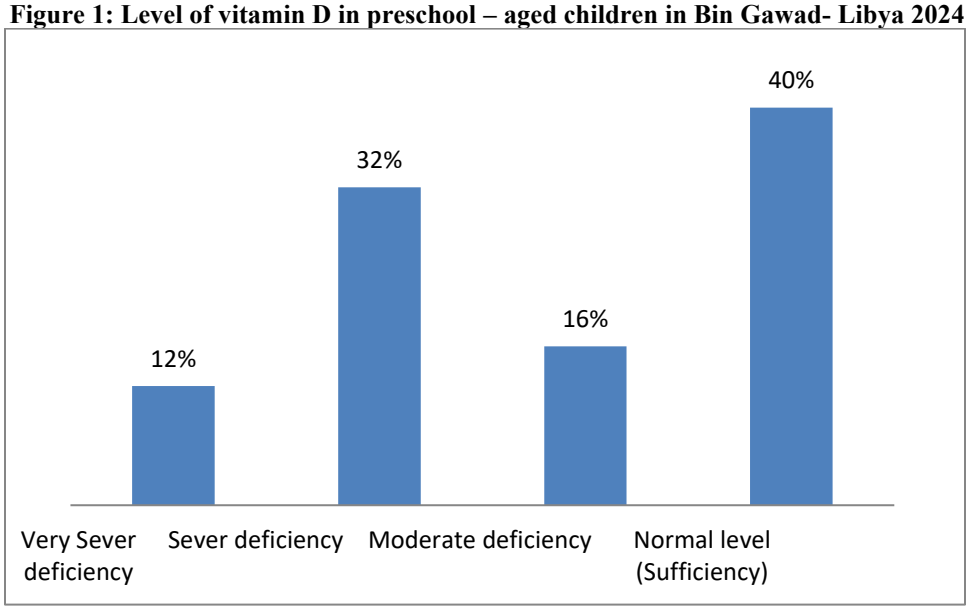
The study adhered to ethical principles for research involving human participants. Written informed consent was obtained from all mothers after explaining the study's purpose, procedures, and voluntary nature of participation. Ethical clearance was granted through institutional endorsement by Khalij Al-Sidra University, and formal permission to access health facilities was secured from the Khalij Al-Sidra Municipality. No incentives were offered, and all data were anonymized to protect participant confidentiality.

RESULTS

Through this descriptive cross-sectional study, conducted in the Bin Jawad region in Libya 2024, which aimed to assess the prevalence and contributing factors of vitamin D and calcium deficiency among preschool-aged children in Bin Jawad -Libya, the results were as follows :

Results of blood samples to detect the level of vitamin D and Calcium:

Figure 1: Level of vitamin D in preschool – aged children in Bin Gawad- Libya 2024



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Figure 2: Level of vitamin D in preschool – aged children according to sex in Bin Gawad- Libya 2024

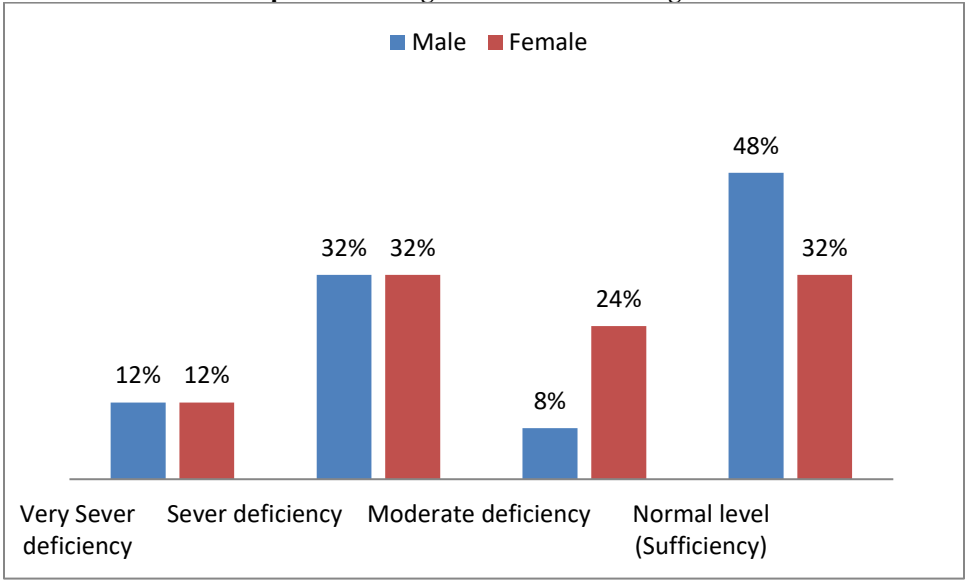


Figure 3: Children from 7to 24 and 25 to 36 months

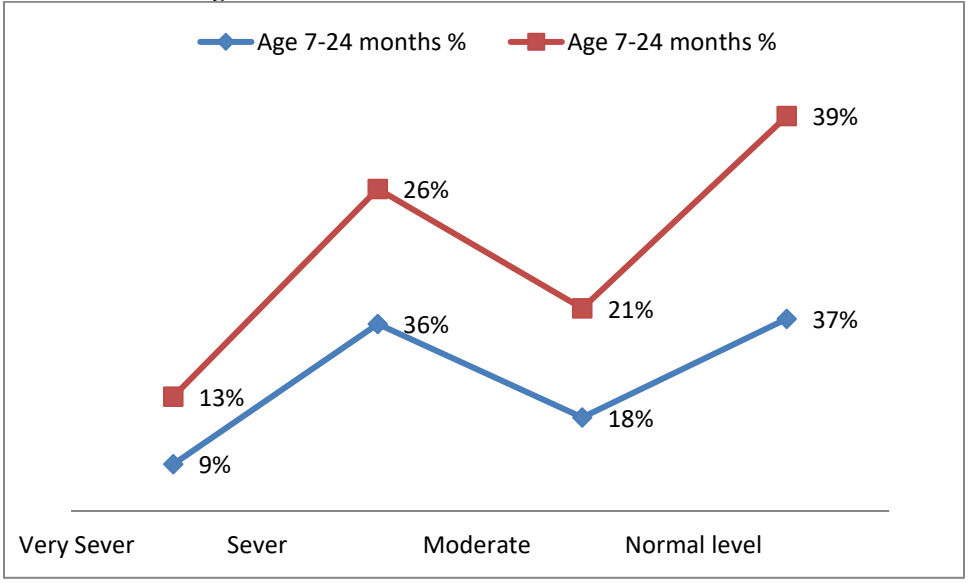


Table 1: Children from 36 an above (total of children in this groups are 16 child)

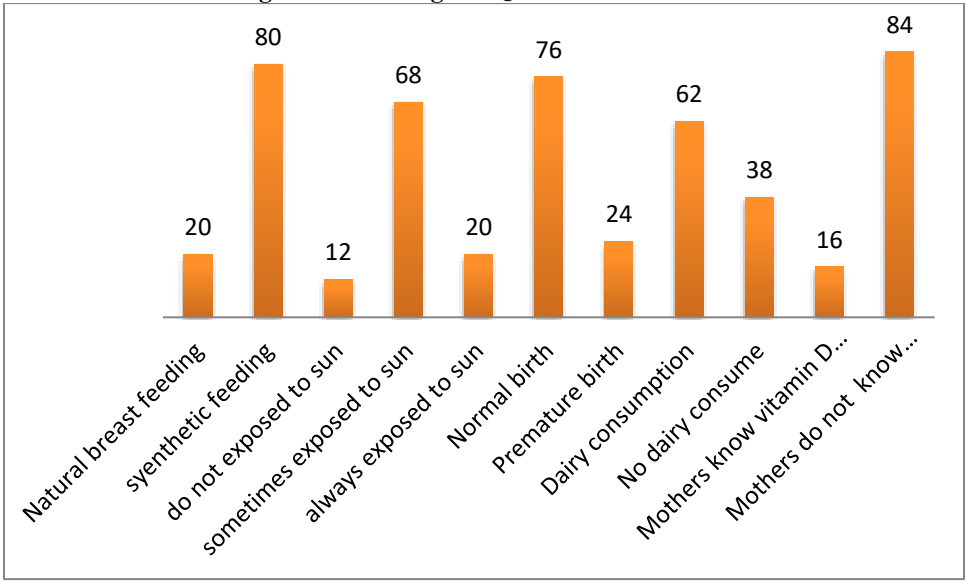
Level	Vi D/ (ng/mL)	percentage %	%0f deficiency
Very Sever deficiency	≥10	13 %	
Sever deficiency	< 10 – ≥ 20	37 %	
Moderate deficiency	21 – 29	6%	56%
Normal level (Sufficiency)	≤30	44 %	
Total		100 %	

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Table 2: Level of Calcium in preschool – aged children based in age in Bin Gawad- Libya 2024:

Level	Ca (ml/dl)	Percentage %	% Of Hypocalcemia
Mild Hypocalcemia	8.0 - 8.8	24 %	38%
Severe Hypocalcemia	> 8.0	14 %	
Mild Hypercalcemia	<10.8 - 12.0	4%	
Normal	<8.8 - 10.8	58%	

Figure 4: Showing the Questionnaire results



DISCUSSION

This study identified significant issues related to inadequate sun exposure and poor nutritional habits among children in the Bin Jawad area. Disordered eating behaviors, characterized by irregular meal patterns and insufficient consumption of dairy products, fish, vegetables, and meat, were major contributing factors to deficiencies in essential nutrients, particularly calcium and vitamin D.The findings revealed a high prevalence of vitamin D deficiency, affecting 60% of the children. This rate is consistent with a study conducted in Northwestern Libya (Al-Khoms), which found that 92.6% of children (aged 1-13 years) had vitamin D levels below 20 ng/mL, indicating deficiency. Notably, 40.5% had levels below 10 ng/mL, indicating severe deficiency. That study concluded that vitamin D deficiency is a "major health problem" among children in the region, attributing it to insufficient sun exposure and low dietary intake. When analyzing vitamin D levels by age, the highest deficiency rate was found in children aged 7 to 24 months. This finding can be explained by the low rate of sun exposure, as 68% of the children had consistently limited sun exposure. This aligns with the well-established principle, noted by M. Fewtrell, that exposure to natural sunlight is a primary source of vitamin D. It is also supported by a study in Tripoli on infants and their mothers, which revealed a high percentage of vitamin D deficiency among exclusively breastfed infants and their mothers, suggesting a transmission of deficiency. This underscores the critical need for maternal supplementation during pregnancy and lactation, and for infant supplementation from birth.Conversely, the lowest proportions of vitamin D deficiency were found in the older age groups (25-36 months and 37-60 months). This improvement may be attributed to these children's increased mobility, greater outdoor activity, and higher consumption of dairy products, reported by 62% of participants. This finding agrees with J. Moan et al. regarding the importance of diet and sun exposure for maintaining adequate vitamin D levels.Regarding calcium, the deficiency rate was lower (26%) compared to that of vitamin D. This clear disparity suggests that calcium deficiency may not be directly correlated with vitamin D deficiency in this specific cohort, a finding that contrasts with a study from Jeddah, Saudi Arabia, which emphasized their

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interrelationship. The calcium deficiency observed here is likely linked to the insufficient consumption of dairy products, reported by 38% of participants. This association is consistent with established knowledge, as referenced in a study from the Aljufra Municipality of Libya, which confirms that dairy products are rich sources of calcium. Furthermore, the high rate of premature birth (74%) could be another contributing factor to calcium deficiency, which aligns with the findings of J.A. Beto, who noted that prematurity and low birth weight are significant risk factors.Concerning the relationship between gender and deficiencies, the mean vitamin D level was lower in males (30.60 ± 22.46) than in females (32.72 ± 23.44). However, this difference was statistically insignificant ($p = 0.746$), indicating no significant association between vitamin D deficiency and gender in this study. This result differs from the findings of another study [15], which reported a gender-based relationship. Similarly, for calcium, the mean level was lower in males (8.66 ± 0.93) than in females (8.93 ± 0.63), but this difference was also not statistically significant ($p = 0.232$). This confirms that no demonstrable relationship between calcium deficiency and gender was found within this study population.

CONCLUSION

This study demonstrated a high prevalence of vitamin D deficiency among children aged five years and younger in the Bin Jawad region. It also found no statistically significant relationship between vitamin D deficiency and sex, nor between vitamin D and calcium deficiency levels. Additionally, the study revealed a high rate of formula feeding, which appears to negatively affect vitamin D and calcium levels in children.

RECOMMENDATIONS

- It necessary for children to be exposed to sunlight to obtain a sufficient amount of vitamin D.
- The necessity for increased awareness among mothers regarding the dietary sources and importance of calcium and vitamin D, as well as the potential health risks associated with their deficiencies .
- There was an urgent need for public health initiatives aimed at improving nutritional practices and ensuring that children in the region received the necessary nutrients for a healthy future.

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