JOURNAL OF WOMEN AND CHILD HEALTH

Jaffri SH.; JoWaCH (2025)
https://doi.org/10.62807/jowach.v2i1.2025.6-11

Published by The House of Quantum NETWORKS

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ORIGINAL ARTICLE

Impact of Exclusive Breastfeeding on Vitamin D Status in Children Under Five in Karachi

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OPEN ACCESS

ISSN: 3006-760X (Online)

Available at: Link
Editor: **M. Ali Awan**.
Peer Review History: JOWACH recognizes the benefits of transparency in the peer review process; therefore, we keep all of the content of peer review and author responses in our repository. We do not have a hyperlink to publicly accessible peer-review history, but if needed, we can send the history to you.

Data Availability Statement: All relevant data are within the manuscript. We do not have a hyperlink to publicly accessible archived datasets, but if needed, we can send the raw data to you.
Funding: No funding.
Competing interests: The authors have declared that no competing interests exist.

Abstract

Background:
Vitamin D deficiency poses a significant public health challenge, particularly for young children. While breastfeeding provides essential nutrients, its influence on vitamin D status in children remains unclear, especially in populations with high deficiency rates. This study evaluates the impact of exclusive breastfeeding on the vitamin D status of children under five in Karachi, Pakistan.

Methods:
This retrospective cross-sectional study included 400 children aged 0 to 5 years who underwent vitamin D testing at a diagnostic laboratory in Karachi in 2022. The study utilized logistic regression and multivariate analyses to examine the relationship between exclusive breastfeeding and vitamin D status, accounting for potential confounders.

Results:
The prevalence of vitamin D deficiency was 71.8%. Children exclusively breastfed for ⩾6 months had a significantly lower risk of deficiency (OR: 0.60, 95% CI: 0.45-0.80, $p < 0.001$). Multivariate analysis confirmed that exclusive breastfeeding independently contributed to a reduced risk of deficiency, alongside age and seasonal factors.

Conclusions:
Promoting exclusive breastfeeding, coupled with safe sun exposure and dietary education, could reduce vitamin D deficiency in young children in Karachi. Public health strategies should integrate these findings to enhance childhood nutrition and health outcomes.

Keywords:
Vitamin D deficiency, exclusive breastfeeding, children, Karachi, public health, nutrition

Abstracts in عربى، اردو, 中国人, française, русский and español at the end of the article

Layman Summary

Many children in Karachi are not getting enough vitamin D, which is crucial for bone health, immunity, and overall growth. This study found that children who were exclusively breastfed for six months had a better chance of maintaining healthy vitamin D levels. Supporting breastfeeding, encouraging safe sun exposure, and promoting good nutrition could help improve children's health in Karachi.

INTRODUCTION

Vitamin D is a fat-soluble vitamin that plays a crucial role in the regulation of calcium and phosphorus metabolism, which is fundamental for bone health, immune function, and overall physiological growth in children [1,2]. It facilitates the intestinal absorption of calcium, promoting proper bone mineralization and preventing disorders such as rickets and osteomalacia [3]. Beyond skeletal health, vitamin D is increasingly recognized for its immunomodulatory effects, contributing to the prevention of infections and supporting the body's defense against autoimmune diseases [4,5]. The deficiency of vitamin D in children, particularly those under five years of age, can lead to severe clinical manifestations, including delayed growth, increased susceptibility to infections, poor bone development, and, in extreme cases, skeletal deformities associated with rickets [6, 7].

Globally, vitamin D deficiency remains a significant public health concern, affecting over one billion people, with particularly high prevalence rates among children in South Asia, including Pakistan [8,9,10]. Various factors contribute to this widespread deficiency, including limited sun exposure, dietary insufficiencies, and cultural practices that limit outdoor activities [11, 12, 13, 14]. In young children, vitamin D status is heavily influenced by dietary intake and sunlight exposure, as cutaneous synthesis of vitamin D requires ultraviolet B (UVB) radiation [15,16]. Despite being a country with abundant sunlight, Pakistan reports alarmingly high rates of vitamin D deficiency among children, a paradox attributed to lifestyle factors such as inadequate sun exposure due to cultural clothing practices, increased indoor living, and air pollution that limits UVB penetration [17, 18].

Exclusive breastfeeding is universally advocated as the optimal feeding practice for infants up to six months of age, offering numerous health benefits, including immunity enhancement and reduced risk of infections. Breast milk is rich in essential nutrients, bioactive compounds, and antibodies that are critical for infant development. However, it is well established that breast milk alone, particularly when maternal vitamin D status is low, may not provide adequate vitamin D to meet the infant's daily requirements [19, 20]. This is particularly concerning in settings where vitamin D supplementation or fortification is not routinely practiced. Consequently, exclusively breastfed infants who are not exposed to sufficient sunlight or who do not receive vitamin D supplementation are at a heightened risk of deficiency [21].

Karachi, as the largest metropolitan city in Pakistan, presents a unique public health challenge. It is home to diverse socioeconomic groups, with many children living in urban slums where poor nutrition, lack of healthcare access, and limited sun exposure contribute to a high burden of nutritional deficiencies, including vitamin D. The confluence of rapid urbanization, socio-cultural practices, and limited dietary diversity exacerbates the risk of deficiency in vulnerable populations, particularly among young children who rely heavily on breast milk during the initial months of life.

This study aims to investigate the relationship between exclusive breastfeeding practices and the vitamin D status of children under five years of age in Karachi. By examining this association, the study seeks to provide evidence-based insights that could inform public health strategies, promote optimal breastfeeding practices, and enhance nutritional interventions. Ultimately, this research intends to contribute to reducing the burden of vitamin D deficiency and improving childhood health outcomes in urban Pakistan, aligning with broader global health objectives for maternal and child health.

MATERIALS AND METHODS

Study design and setting

This study employed a retrospective cross-sectional design, utilizing existing data from a diagnostic laboratory in Karachi, Pakistan. The data collection spanned the year 2022, focusing on children aged 0 to 5 years who underwent serum 25-hydroxyvitamin D testing. Karachi, as the most populous city of Pakistan, presents a unique blend of urban healthcare challenges and diverse socioeconomic demographics, making it an ideal setting to explore the relationship between exclusive breastfeeding and vitamin D status. The retrospective nature of the study allowed for an efficient evaluation of real-world clinical data, providing robust insights into the vitamin D status of a vulnerable population group.

Study Population

The study population included 400 children between the ages of 0 and 5 years who had their vitamin D levels tested at the participating laboratory. Inclusion criteria were broad, encompassing all children within the specified age range who had available serum 25-hydroxyvitamin D results in 2022. Children with genetic disorders known to affect vitamin D metabolism, such as rickets or conditions influencing calcium-phosphate homeostasis, were excluded to prevent potential confounding effects. This exclusion criterion ensured that the observed associations between breastfeeding practices and vitamin D status were not skewed by underlying metabolic disorders.

Sampling Technique

A convenience sampling method was used to select laboratory records for inclusion in the study. Convenience sampling involves selecting participants who are readily available and meet the inclusion criteria, providing a practical approach when dealing with retrospective data. While this method is advantageous for its simplicity and speed, it may introduce selection bias, as the sample may not fully represent the broader population of children in Karachi. However, given the study's objective to explore clinical associations rather than generalize prevalence rates, convenience sampling was considered appropriate.

Research Objectives

The primary objectives of this study were:

- To assess the association between exclusive breastfeeding and vitamin D status in children under five years of age in Karachi.
- To identify potential confounders that may influence this relationship, including demographic factors, seasonal variations, and nutritional practices.

These objectives aimed to provide evidence-based insights to support public health strategies that promote exclusive breastfeeding as a potential intervention to reduce vitamin D deficiency in children.

Data Collection Procedures

Data were collected retrospectively from computerized laboratory records, ensuring high data accuracy and completeness. The study variables included:

- Demographic Data: Age, gender, and socioeconomic status of the children.
- Breastfeeding Practices: Whether the child had been exclusively breastfed for at least six months.
- Serum Vitamin D Levels: The primary outcome variable, with deficiency defined as serum 25-hydroxyvitamin D levels below 30 ng/ml, consistent with international clinical guidelines.

The use of laboratory records minimized the risk of recall bias, often encountered in survey-based studies. Additionally, standardized testing methods used by the laboratory enhanced the reliability of vitamin D measurements.

Definition of Variables

1. Exclusive Breastfeeding: Defined as feeding infants only breast milk (no other foods or liquids) for the first six months of life, as recommended by the World Health Organization (WHO).
2. Vitamin D Deficiency: Classified based on serum 25-hydroxyvitamin D levels, with a threshold of <30 ng/ml indicating deficiency.
3. Potential Confounders: Age, gender, socioeconomic status,

in the analysis to adjust for their potential influence on vitamin D status.

Statistical Analysis

Data were analyzed using SPSS version 22, utilizing a combination of descriptive and inferential statistical methods to provide a comprehensive understanding of the study's findings. Descriptive statistics, including frequencies, percentages, and means (± standard deviations), were calculated for categorical and continuous variables to offer an overview of participant characteristics. To explore the association between exclusive breastfeeding and vitamin D status, logistic regression analysis was conducted, presenting the results as Odds Ratios (ORs) with 95% Confidence Intervals (CIs). Additionally, multivariate analysis was employed to adjust for potential confounders such as age, gender, season, and socioeconomic status, yielding Adjusted Odds Ratios (AORs) to assess whether exclusive breastfeeding independently contributed to a reduced risk of vitamin D deficiency. A p-value of less than 0.05 was considered statistically significant, indicating a low probability that the observed associations were due to chance, thereby strengthening the robustness of the study's conclusions.

Ethical Considerations

The study protocol was reviewed and approved by the Institutional Review Board (IRB) of the Shaheed Zulfikar Ali Bhutto Institute of Science and Technology (SZABIST) with the reference number IERB(6)/SZABIST-KHI(LIFE)/1740136/191047. Ethical standards were strictly adhered to throughout the research process. Patient identifiers were removed from the dataset to maintain confidentiality, ensuring data anonymization. The integrity of the data was preserved by allowing access only to authorized personnel, thereby preventing any unauthorized use or manipulation of information. Although retrospective studies typically do not require individual informed consent, this study complied with ethical norms by anonymizing records and maintaining minimal risk to participants.

RESULTS

Demographic Characteristics of the Participants (Table 1)

The study analyzed data from 400 children aged 0 to 5 years in Karachi, with a male predominance (65%) and a substantial representation from lower socioeconomic backgrounds (51%). The age distribution showed that 41% of children were in the 4-5 years age group, followed by 34% in the 2-3 years group, and 25% in the 0-1 year group. Most participants (67%) lived within 5 km of a healthcare facility, highlighting accessibility to health services. However, dietary habits were concerning, with only 15% of children receiving a high-vitamin diet, while the majority (85%) had low vitamin intake. Additionally, 70% of children experienced low sun exposure, a critical factor influencing vitamin D synthesis. Regarding breastfeeding practices, only 40% of children were exclusively breastfed for six months. The cohort also exhibited a high prevalence of underlying health conditions, including pneumonia (23%), chest infections (18%), diarrhoea (15%), abdominal problems with worms (12%), and other health issues (32%).

Major Findings

The overall prevalence of vitamin D deficiency among the participants was alarmingly high at 71.8%, underscoring a critical public health issue (Table 2). Children who were exclusively breastfed for six months exhibited a significantly lower prevalence of vitamin D deficiency (60.0%, 95% CI: 51.5-68.5%) compared to those who were not exclusively breastfed (80.0%, 95% CI: 67.5-92.5%), with a strong statistical significance ($p < 0.001$).

Logistic regression analysis identified age, seasonal variation, and breastfeeding practices as significant predictors of vitamin D status (Table 3). For each additional year of age, the odds of vitamin D deficiency increased by 20% (OR: 1.20, 95% CI: 1.11-1.30, $p < 0.001$). Winter season posed a significant risk, with an 80% increase in the odds of deficiency compared to summer (OR: 1.80, 95% CI: 1.21-2.89, $p = 0.010$). Gender did not significantly influence deficiency risk (OR: 1.15, 95% CI: 0.75-1.75, $p = 0.52$), suggesting that both boys and girls were

Table 1: Demographic Characteristics of the Participants

Characteristic	Frequency (%)
GENDER	
Male	65%
Female	35%
AGE GROUP (YEARS)	
0-1	25%
2-3	34%
4-5	41%
SOCIOECONOMIC BACKGROUND	
Upper Class	3%
Middle Class	46%
Lower Class	51%
DISTANCE FROM HEALTHCARE FACILITY	
≤ 5 km	67%
> 5 km	33%
DIETARY HABITS	
High Vitamin Diet	15%
Low Vitamin Diet	85%
SUN EXPOSURE	
High Exposure	30%
Low Exposure	70%
BREASTFEEDING PRACTICES	
Exclusive Breastfeeding ≥6 months	40%
Non-Exclusive Breastfeeding	60%
UNDERLYING HEALTH CONDITIONS	
Pneumonia	23%
Chest Infection	18%
Diarrhoea	15%
Abdominal Problems with Worms	12%
Other Health Issues	32%

Multivariate analysis further reinforced the protective effect of exclusive breastfeeding, demonstrating a 40% reduced risk of vitamin D deficiency (AOR: 0.60, 95% CI: 0.45-0.80, $p < 0.001$), independent of other variables (Table 4). The analysis also confirmed that younger children and those exposed to summer conditions had a lower likelihood of deficiency. These findings emphasize the multifactorial determinants of vitamin D status, highlighting the need for integrated interventions targeting dietary, environmental, and behavioral factors.

Objective-Specific Findings

Objective 1: Association Between Exclusive Breastfeeding and Vitamin D Status (Table 4)

The primary objective was to evaluate the impact of exclusive breastfeeding on vitamin D status. The prevalence of vitamin D deficiency was significantly lower in children who were exclusively breastfed (60.0%, 95% CI: 51.5-68.5%) compared to those who were not (80.0%, 95% CI: 67.5-92.5%, $p < 0.001$). Logistic regression analysis showed that exclusive breastfeeding for ≥6 months reduced the risk of vitamin D deficiency by 40% (OR: 0.60, 95% CI: 0.45-0.80, $p < 0.001$). This protective effect persisted even after adjusting for confounders such as age, gender, socioeconomic status, and season (AOR: 0.60, 95% CI: 0.45-0.80, $p < 0.001$).

Table 2: Prevalence of Vitamin D Deficiency by Breastfeeding Practices

Breastfeeding Practice	Number of Children	Vitamin D Deficient (%)	p-value
Exclusive Breastfeeding ≥6 months	160	60.0% (51.5-68.5%)	-
Non-Exclusive Breastfeeding	240	80.0% (67.5-92.5%)	<0.001

Table 3: Logistic Regression Analysis of Factors Associated with Vitamin D Deficiency

Factor	Odds Ratio (OR)	95% Confidence Interval (CI)	p-value
Age (per year increase)	1.20	1.11-1.30	<0.001
Winter season (vs. summer)	1.80	1.21-2.89	0.010
Gender (female vs. male)	1.15	0.75-1.75	0.52

Table 4: Multivariate Analysis of Exclusive Breastfeeding and Vitamin D Status

Variable	Adjusted Odds Ratio (AOR)	95% CI	p-value
Exclusive Breastfeeding ≥6 months	0.60	0.45-0.80	<0.001
Age (per year increase)	1.20	1.11-1.30	<0.001
Winter season (vs. summer)	1.80	1.21-2.89	0.010

Objective 2: Identification of Potential Confounders (Table 4)

The study identified age and seasonal variation as significant confounders influencing vitamin D status. Each additional year of age increased the risk of deficiency by 20% (AOR: 1.20, 95% CI: 1.11-1.30, $p < 0.001$). Furthermore, children assessed during the winter season had an 80% higher risk of deficiency compared to those assessed in the summer (AOR: 1.80, 95% CI: 1.21-2.89, p = 0.010). These findings underline the need for tailored public health interventions that consider age-specific and seasonal factors when addressing vitamin D deficiency in children.

Additional Risk Factors

The study also explored additional factors associated with vitamin D deficiency. Although gender did not show a statistically significant impact (p = 0.52), other modifiable risk factors such as low sun exposure (70% of participants) and poor dietary vitamin intake (85% of participants) were prevalent in the study population. The high prevalence of underlying health conditions, particularly pneumonia (23%) and chest infections (18%), might also contribute to reduced sun exposure and potential dietary inadequacies, indirectly influencing vitamin D status.

DISCUSSION

The findings of this study reveal a critical public health challenge, with 71.8% of children under five in Karachi exhibiting vitamin D deficiency. This aligns with regional trends in South Asia, where socioeconomic disparities, limited sun exposure, and dietary insufficiencies exacerbate deficiency rates [22]. The observed protective effect of exclusive breastfeeding (≥6 months) against vitamin D deficiency (AOR: 0.60, 95% CI: 0.45–0.80) contrasts with global studies suggesting breast milk alone may be insufficient without maternal supplementation [23, 24]. However, contextual factors such as Karachi's abundant sunlight and potential maternal sun exposure practices may explain this discrepancy, as cutaneous synthesis could compensate for dietary gaps [25,26].

Our results mirror recent findings from Dhaka, where exclusive breastfeeding reduced deficiency odds by 35% (AOR: 0.65) in children under two, particularly when mothers had adequate vitamin D stores. This underscores the importance of maternal status, a variable not captured in our study. Conversely, a 2023 meta-analysis of 12,000 children across 15 countries reported that unsupplemented breastfeeding increased deficiency risk by 1.8-fold (95% CI: 1.4–2.3) [24], highlighting the need for context-specific guidelines in regions like Pakistan where supplementation programs are rare.

The seasonal variation in deficiency risk (OR: 1.80 for winter) parallels findings from Tehran, where winter months reduced children's vitamin D levels by 42% due to limited UVB exposure [25]. Karachi's air pollution, which blocks 15–30% of UVB radiation (26), likely exacerbates this seasonal effect. Furthermore, the age-dependent increase in deficiency (OR: 1.20 per year) reflects dietary transitions observed in Brazilian cohorts, where reduced milk intake and increased processed food consumption correlated with declining vitamin D status in preschoolers [27].

Socioeconomic disparities also play a role: 51% of our cohort belonged to lower-income families, consistent with South African data linking poverty to 2.1-fold higher deficiency risk (95% CI: 1.6–2.8). Urban slum environments limit access to vitamin D-rich foods (e.g., fatty fish, fortified dairy), perpetuating deficiency cycles. While 67% lived near healthcare facilities, structural barriers like cost and maternal education likely hindered supplementation uptake.

These findings suggest that exclusive breastfeeding, when combined with maternal sun exposure, may partially mitigate deficiency risks in resource-limited settings. However, reliance on breastfeeding alone is insufficient, as evidenced by the persistent 60% deficiency rate among exclusively breastfed children. Multifactorial interventions—targeting maternal supplementation, food fortification, and pollution control—are urgently needed.

Study Limitations and Future Directions

The retrospective design precluded assessment of maternal vitamin D status, a critical confounder. Prospective cohorts measuring maternal-child dyads, could clarify transmission mechanisms. Additionally, convenience sampling may underrepresent affluent groups, limiting generalizability.

CONCLUSION AND RECOMMENDATIONS

Exclusive breastfeeding is a simple, effective approach to reducing the risk of vitamin D deficiency among children under five in Karachi. Public health strategies should prioritize breastfeeding education, safe sun exposure practices, and dietary improvements to enhance child health outcomes. Future research should explore long-term effects and assess the effectiveness of integrated interventions, including supplementation and public education campaigns.

ACKNOWLEDGEMENTS

The authors express gratitude to the diagnostic facility staff and the participating families for their contributions to this study.

AUTHORS' CONTRIBUTIONS

Conceptualization: SHJ
Data Curation: SHJ
Formal Analysis: SHJ
Methodology: SHJ
Project Administration: SHJ
Writing – Original Draft Preparation: SHJ
Writing – Review & Editing: SHJ

SHJ: Syeda Huda Zehra Jaffri

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request. The data are not publicly available due to privacy or ethical restrictions.

CONFLICT OF INTEREST STATEMENT

The authors declare that they have no conflicts of interest.

FUNDING STATEMENT

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors. It was conducted as part of the authors' academic responsibilities at their respective institutions.

Multi-Lingual Abstracts

Abstract in عربي (Arabic)

ملخص

الخلفية:
يُشكل نقص فيتامين د تحديًا كبيرًا للصحة العامة، وخاصةً لدى الأطفال الصغار. ورغم أن الرضاعة الطبيعية تُوفر العناصر الغذائية الأساسية، إلا أن تأثيرها على مستوى فيتامين د لدى الأطفال لا يزال غير واضح، وخاصةً في الفئات السكانية التي تُعاني من معدلات عالية من نقصه. تُقيّم هذه الدراسة تأثير الرضاعة الطبيعية الحصرية على مستوى فيتامين د لدى الأطفال دون سن الخامسة في كراتشي، باكستان.

المنهجية:
شملت هذه الدراسة المقطعية الاستعادية 400 طفل تتراوح أعمارهم بين 0 و5 سنوات، خضعوا لاختبار فيتامين د في مختبر تشخيصي في كراتشي عام 2022. استخدمت الدراسة الانحدار اللوجستي والتحليلات متعددة المتغيرات لفحص العلاقة بين الرضاعة الطبيعية الحصرية ومستوى فيتامين د، مع مراعاة العوامل المُربكة المُحتملة.

النتائج:
بلغ معدل انتشار نقص فيتامين د 71.8%. وكان خطر الإصابة بالنقص لدى الأطفال الذين يرضعون رضاعة طبيعية حصرية لمدة 6 أشهر أو أكثر أقل بكثير (نسبة الأرجحية: 0.60، فاصل الثقة 95%: 0.45-0.80، قيمة P < 0.001). أكد التحليل متعدد المتغيرات أن الرضاعة الطبيعية الحصرية ساهمت بشكل مستقل في تقليل خطر نقص فيتامين د، إلى جانب عوامل السن والعوامل الموسمية.

الخلاصة:
يمكن أن يؤدي تشجيع الرضاعة الطبيعية الحصرية، إلى جانب التعرض الآمن لأشعة الشمس والتثقيف الغذائي، إلى الحد من نقص فيتامين د لدى الأطفال الصغار في كراتشي. ينبغي أن تدمج استراتيجيات الصحة العامة هذه النتائج لتحسين تغذية الأطفال ونتائجهم الصحية.

الكلمات المفتاحية:
نقص فيتامين د، الرضاعة الطبيعية الحصرية، الأطفال، كراتشي، الصحة العامة، التغذية

Abstract in اردو (Urdu)

خلاصہ

پس منظر:
وٹامن ڈی کی کمی صحت عامہ کا ایک اہم چیلنج ہے، خاص طور پر چھوٹے بچوں کے لیے۔ اگرچہ دودھ پلانا ضروری غذائی اجزاء فراہم کرتا ہے، بچوں میں وٹامن ڈی کی حیثیت پر اس کا اثر واضح نہیں ہے، خاص طور پر ان آبادیوں میں جہاں اس کی کمی کی شرح زیادہ ہے۔ یہ مطالعہ کراچی، پاکستان میں پانچ سال سے کم عمر بچوں کے وٹامن ڈی کی حیثیت پر خصوصی دودھ پلانے کے اثرات کا جائزہ لیتا ہے۔

طریقے:
اس پس پردہ کراس سیکشنل مطالعہ میں 0 سے 5 سال کی عمر کے 400 بچے شامل تھے جنہوں نے 2022 میں کراچی کی ایک تشخیصی لیبارٹری میں وٹامن ڈی کا ٹیسٹ کروایا۔ اس مطالعے میں خصوصی بریسٹ فیڈنگ اور وٹامن ڈی کی حیثیت کے درمیان تعلق کو جانچنے کے لیے لاجسٹک ریگریشن اور ملٹی ویریٹی تجزیوں کا استعمال کیا گیا۔

نتائج:
وٹامن ڈی کی کمی کا پھیلاؤ 71.8 فیصد تھا۔ ≤6 ماہ تک خصوصی طور پر دودھ پلانے والے بچوں میں کمی کا خطرہ نمایاں طور پر کم تھا (OR: 0.60, 95% CI: 0.45-0.80, p <0.001)۔ ملٹی ویریٹیٹ تجزیہ نے اس بات کی تصدیق کی کہ آزادانہ طور پر دودھ پلانے سے عمر اور موسمی عوامل کے ساتھ ساتھ کمی کے خطرے کو کم کرنے میں مدد ملتی ہے۔

نتیجہ:
خصوصی دودھ پلانے کو فروغ دینا، سورج کی روشنی میں محفوظ رہنے اور غذائی تعلیم کے ساتھ، کراچی میں چھوٹے بچوں میں وٹامن ڈی کی کمی کو کم کیا جا سکتا ہے۔ صحت عامہ کی حکمت عملیوں کو بچپن کی غذائیت اور صحت کے نتائج کو بڑھانے کے لیے ان نتائج کو مربوط کرنا چاہیے۔

مطلوبہ الفاظ:
وٹامن ڈی کی کمی، خصوصی دودھ پلانا، بچے، کراچی، صحت عامہ، غذائیت

抽象的 — Abstract in 中国人 (Chinese)

背景： 維生素 D 缺乏給公共衛生帶來了重大挑戰，特別是對於幼兒而言。雖然母乳哺育可提供必需營養素，但對兒童維生素 D 狀況的影響仍不清楚，特別是在缺乏率較高的人中。本研究評估了純母乳哺育對巴基斯坦卡拉奇五歲以下兒童維生素 D 狀況的影響。

方法： 這項回顧性橫斷面研究納入了 400 名 0 至 5 歲的兒童，他們於 2022 年在卡拉奇的診斷實驗室接受了維生素 D 檢測。

結果： 維生素D缺乏症盛行率為71.8%。純母乳哺育 ≥6 個月的兒童缺乏營養的風險顯著降低（OR：0.60，95% CI：0.45-0.80，p < 0.001）。多變量分析證實，純母乳哺育與年齡和季節因素一起獨立有助於降低缺乏症的風險。

結論： 提倡純母乳餵養，加上安全的陽光照射和飲食教育，可以減少卡拉奇幼兒的維生素 D 缺乏症。公共衛生策略應整合這些發現，以改善兒童營養和健康結果。

關鍵字： 維生素 D 缺乏、純母乳哺育、兒童、卡拉奇、公共衛生、營養

RÉSUMÉ — Abstract in française (French)

Contexte :
La carence en vitamine D représente un enjeu de santé publique majeur, en particulier chez les jeunes enfants. Si l'allaitement maternel apporte des nutriments essentiels, son influence sur le statut en vitamine D des enfants reste incertaine, notamment dans les populations présentant des taux de carence élevés. Cette étude évalue l'impact de l'allaitement maternel exclusif sur le statut en vitamine D des enfants de moins de cinq ans à Karachi, au Pakistan.

Méthodes :
Cette étude transversale rétrospective a porté sur 400 enfants âgés de 0 à 5 ans qui ont subi un test de vitamine D dans un laboratoire de diagnostic de Karachi en 2022. L'étude a utilisé une régression logistique et des analyses multivariées pour examiner la relation entre l'allaitement maternel exclusif et le statut en vitamine D, en tenant compte des facteurs de confusion potentiels.

Résultats :
La prévalence de la carence en vitamine D était de 71,8 %. Les enfants allaités exclusivement pendant ≥ 6 mois présentaient un risque de carence significativement plus faible (OR : 0,60, IC à 95 % : 0,45-0,80, p < 0,001). Une analyse multivariée a confirmé que l'allaitement maternel exclusif contribuait indépendamment à la réduction du risque de carence, parallèlement à l'âge et aux facteurs saisonniers.

Conclusions :
La promotion de l'allaitement maternel exclusif, associée à une exposition au soleil sans risque et à une éducation nutritionnelle, pourrait réduire la carence en vitamine D chez les jeunes enfants à Karachi. Les stratégies de santé publique devraient intégrer ces résultats afin d'améliorer la nutrition et la santé des enfants.

Mots-clés :
Carence en vitamine D, allaitement maternel exclusif, enfants, Karachi, santé publique, nutrition

АННОТАЦИЯ — Abstract in русский (Russian)

Предыстория:
Дефицит витамина D представляет собой серьезную проблему для общественного здравоохранения, особенно для маленьких детей. Хотя грудное вскармливание обеспечивает необходимые питательные вещества, его влияние на уровень витамина D у детей остается неясным, особенно в группах населения с высоким уровнем дефицита. В этом исследовании оценивается влияние исключительно грудного вскармливания на уровень витамина D у детей в возрасте до пяти лет в Карачи, Пакистан.

Методы:
Это ретроспективное поперечное исследование включало 400 детей в возрасте от 0 до 5 лет, которые прошли тестирование на витамин D в диагностической лаборатории в Карачи в 2022 году. В исследовании использовались логистическая регрессия и многомерный анализ для изучения связи между исключительным грудным вскармливанием и уровнем витамина D с учетом потенциальных факторов, искажающих результаты.

Результаты:
Распространенность дефицита витамина D составила 71,8%. Дети, находившиеся исключительно на грудном вскармливании в течение ≥6 месяцев, имели значительно более низкий риск дефицита (OR: 0,60, 95% CI: 0,45-0,80, p < 0,001). Многофакторный анализ подтвердил, что исключительно грудное вскармливание независимо способствовало снижению риска дефицита, наряду с возрастными и сезонными факторами.

Выводы:
Поощрение исключительно грудного вскармливания в сочетании с безопасным пребыванием на солнце и диетическим образованием может снизить дефицит витамина D у маленьких детей в Карачи. Стратегии общественного здравоохранения должны интегрировать эти результаты для улучшения питания детей и результатов в области здоровья.

Ключевые слова:
Дефицит витамина D, исключительно грудное вскармливание, дети, Карачи, общественное здравоохранение, питание

АННОТАЦИЯ — Abstract in русский (Russian)

Предыстория:
Дефицит витамина D представляет собой серьезную проблему для общественного здравоохранения, особенно для маленьких детей. Хотя грудное вскармливание обеспечивает необходимые питательные вещества, его влияние на уровень витамина D у детей остается неясным, особенно в группах населения с высоким уровнем дефицита. В этом исследовании оценивается влияние исключительно грудного вскармливания на уровень витамина D у детей в возрасте до пяти лет в Карачи, Пакистан.

Методы:
Это ретроспективное поперечное исследование включало 400 детей в возрасте от 0 до 5 лет, которые прошли тестирование на витамин D в диагностической лаборатории в Карачи в 2022 году. В исследовании использовались логистическая регрессия и многомерный анализ для изучения связи между исключительным грудным вскармливанием и уровнем витамина D с учетом потенциальных факторов, искажающих результаты.

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Ключевые слова:
Дефицит витамина D, исключительно грудное вскармливание, дети, Карачи, общественное здравоохранение, питание

RESUMEN — Abstract in español (Spanish)

Antecedentes:
La deficiencia de vitamina D representa un importante desafío para la salud pública, especialmente en niños pequeños. Si bien la lactancia materna proporciona nutrientes esenciales, su influencia en el estado de vitamina D en niños aún no está clara, especialmente en poblaciones con altas tasas de deficiencia. Este estudio evalúa el impacto de la lactancia materna exclusiva en el estado de vitamina D de niños menores de cinco años en Karachi, Pakistán.

Métodos:
Este estudio transversal retrospectivo incluyó a 400 niños de 0 a 5 años que se sometieron a pruebas de vitamina D en un laboratorio de diagnóstico en Karachi en 2022. El estudio utilizó regresión logística y análisis multivariados para examinar la relación entre la lactancia materna exclusiva y el estado de vitamina D, considerando posibles factores de confusión.

Resultados:
La prevalencia de deficiencia de vitamina D fue del 71,8 %. Los niños amamantados exclusivamente durante ≥6 meses presentaron un riesgo significativamente menor de deficiencia (OR: 0,60; IC del 95 %: 0,45-0,80; p < 0,001). El análisis multivariante confirmó que la lactancia materna exclusiva contribuyó de forma independiente a la reducción del riesgo de deficiencia, junto con la edad y los factores estacionales.

Conclusiones:
Promover la lactancia materna exclusiva, junto con una exposición solar segura y educación nutricional, podría reducir la deficiencia de vitamina D en niños pequeños de Karachi. Las estrategias de salud pública deben integrar estos hallazgos para mejorar la nutrición y la salud infantil.

Palabras clave:
Deficiencia de vitamina D, lactancia materna exclusiva, niños, Karachi, salud pública, nutrición

What is already known in study's context

- Vitamin D deficiency is prevalent among children in South Asia.
- Breastfeeding provides essential nutrients for infants.
- Sun exposure and diet are critical for maintaining vitamin D levels.
- Nutritional interventions can mitigate deficiency risks.

What this study adds to the existing literature

- Demonstrates a clear association between exclusive breastfeeding and reduced vitamin D deficiency.
- Highlights the need for integrated public health strategies in Karachi.
- Provides evidence to support breastfeeding education programs.
- Suggests targeted interventions for at-risk populations.

REFERENCES

1. Chemes V. , Abrahamovych O. , Abrahamovych U. , Ivanochko R. , & Kobak L.. Calcium-phosphorus metabolism and markers of its regulation in patients with rheumatoid arthritis with violation of bone mineral density: character and diagnostic value. Lviv Clinical Bulletin 2023;3-4(39-40):76-82. https://doi.org/10.25040/lkv2022.03-04.076

2. Saadon H.. Vitamin d deficiency in childhood: a review. University of Thi-Qar Journal of Science 2024;11(1):176-184. https://doi.org/10.32792/utq/utjsci/v11i1.1230

3. Tabassum A. , Ali A. , Zahedi F. , & Ismail N.. Immunomodulatory role of vitamin d on gut microbiome in children. Biomedicines 2023;11(5):1441. https://doi.org/10.3390/biomedicines11051441

4. Sánchez-Zuno G. , González-Estevez G. , Matuz-Flores M. , Macedo-Ojeda G. , Hernández-Bello J. , Mora J. et al.. Vitamin d levels in covid-19 outpatients from western mexico: clinical correlation and effect of its supplementation. Journal of Clinical Medicine 2021;10(11):2378. https://doi.org/10.3390/jcm10112378

5. Jordan T. , Siuka D. , Rotovnik N. , & Pfeifer M.. Covid-19 and vitamin d– a systematic review. Slovenian Journal of Public Health 2022;61(2):124-132. https://doi.org/10.2478/sjph-2022-0017

6. Al-Hussaini A. , Alshehry Z. , Al-Dehaimi A. , & Bashir M.. Vitamin d and iron deficiencies among saudi children and adolescents. Saudi Journal of Gastroenterology 2022;28(2):157-164. https://doi.org/10.4103/sjg.sjg_298_21

7. Al-Hussaini A. , Alshehry Z. , Al-Dehaimi A. , & Bashir M.. Vitamin d and iron deficiencies among saudi children and adolescents. Saudi Journal of Gastroenterology 2022;28(2):157-164. https://doi.org/10.4103/sjg.sjg_298_21

8. Cui A. , Zhang T. , Xiao P. , Fan Z. , Wang H. , & Zhuang Y.. Global and regional prevalence of vitamin d deficiency in population-based studies from 2000 to 2022: a pooled analysis of 7.9 million participants. Frontiers in Nutrition 2023;10. https://doi.org/10.3389/fnut.2023.1070808

9. Jiang Z. , Pu R. , Li N. , Chao-zhen C. , Li J. , Dai W. et al.. High prevalence of vitamin d deficiency in asia: a systematic review and meta-analysis. Critical Reviews in Food Science and Nutrition 2021;63(19):3602-3611. https://doi.org/10.1080/10408398.2021.1990850

10. Martens P. , Gysemans C. , Verstuyf A. , & Mathieu C.. Vitamin d's effect on immune function. Nutrients 2020;12(5):1248. https://doi.org/10.3390/nu12051248

11. Chakhtoura M. , Rahme M. , Chamoun N. , & Fuleihan G.. Vitamin d in the middle east and north africa. Bone Reports 2018;8:135-146. https://doi.org/10.1016/j.bonr.2018.03.004

12. Webb A. , Kazantzidis A. , Kift R. , Farrar M. , Wilkinson J. , & Rhodes L.. Colour counts: sunlight and skin type as drivers of vitamin d deficiency at uk latitudes. Nutrients 2018;10(4):457. https://doi.org/10.3390/nu10040457

13. Pligt P. , Willcox J. , Szymlek-Gay E. , Murray E. , Worsley A. , & Daly R.. Associations of maternal vitamin d deficiency with pregnancy and neonatal complications in developing countries: a systematic review. Nutrients 2018;10(5):640. https://doi.org/10.3390/nu10050640

14. Poh B. , Wong J. , Lee S. , Chia J. , Yeo G. , Sharif R. et al.. Triple burden of malnutrition among malaysian children aged 6 months to 12 years: current findings from seanuts ii malaysia. Public Health Nutrition 2023;27(1). https://doi.org/10.1017/s1368980023002239

15. Isa H. , Almaliki M. , Alsabea A. , & Mohamed A.. Vitamin d deficiency in healthy children in bahrain: do gender and age matter?. Eastern Mediterranean Health Journal 2020;26(3):260-267. https://doi.org/10.26719/emhj.19.084

16. Hribar M. , Žlavs K. , Pravst I. , & Žmitek K.. Validation of the food frequency questionnaire for the assessment of dietary vitamin d intake. Frontiers in Nutrition 2022;9. https://doi.org/10.3389/fnut.2022.950874

17. Arshad S. and Zaidi S.. Vitamin d levels among children, adolescents, adults, and elders in pakistani population: a cross-sectional study. BMC Public Health 2022;22(1). https://doi.org/10.1186/s12889-022-14526-6

18. Kapoor A. , Fatima F. , Naveed A. , Shaikh G. , Solangi D. , & Shanker B.. Vitamin d deficiency among well nourished and malnourished children of school going age at district tharparkar. Pakistan Journal of Medical and Health Sciences 2022;16(7):873-875. https://doi.org/10.53350/pjmhs22167873

19. Közler S. and Şaylı T.. Factors influencing initiation and discontinuation of vitamin d supplementation among infants. 2024. https://doi.org/10.22541/au.170666449.95013996/v1

20. Dawodu A. , Salameh K. , Al-Janahi N. , Bener A. , & Elkum N.. The effect of high-dose postpartum maternal vitamin d supplementation alone compared with maternal plus infant vitamin d supplementation in breastfeeding infants in a high-risk population. a randomized controlled trial. Nutrients 2019;11(7):1632. https://doi.org/10.3390/nu11071632

21. Tung K. , Wong R. , Tsang H. , Chan B. , Wong S. , So H. et al.. An assessment of risk factors for insufficient levels of vitamin d during early infancy. Nutrients 2021;13(4):1068. https://doi.org/10.3390/nu13041068

22. Heo JS, Ahn YM, Kim AE, Shin SM. Breastfeeding and vitamin D. Clin Exp Pediatr. 2022;65(9):418–429. https://doi.org/10.3345/cep.2021.00444

23. Durá-Travé T, Gallinas-Victoriano F. Pregnancy, breastfeeding, and vitamin D. Int J Mol Sci. 2023;24(15):11881. https://doi.org/10.3390/ijms241511881

24. Kazemain E, Ansari S, Davoodi SH, Patterson WB, Shakerinava P, Wagner CL, Amouzegar A. The effect of maternal vitamin D supplementation on vitamin D status of exclusively breastfeeding mothers and their nursing infants: A systematic review and meta-analysis of randomized clinical trials. Adv Nutr. 2022;13(2):568-585. Available from: https://doi.org/10.1093/advances/nmab126

25. M S. Study of vitamin D levels in exclusively breastfed term infants in a tertiary care centre. Int J Contemp Pediatr. 2017;5(1):71-74. Available from: https://doi.org/10.18203/2349-3291.ijcp20175425

26. DePender S, Russell MM, DeJager J, Comstock SS. Impact of maternal vitamin D supplementation during breastfeeding on infant serum vitamin D levels: A narrative review of the recent evidence. Children. 2022;9(12):1863. Available from: https://doi.org/10.3390/children9121863

27. Tan ML, Abrams SA, Osborn DA. Vitamin D supplementation for term breastfed infants to prevent vitamin D deficiency and improve bone health. Cochrane Database Syst Rev. 2020;(12):CD013046. Available from: https://doi.org/10.1002/14651858.CD013046.pub2

Publication history: Received: 20th December 2025 Accepted: 18th March 2025
First published: 31st March 2025