

Prevalence of vitamin D deficiency in Saudi newborns at a tertiary care center

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ABSTRACT

الأهداف: تقييم مستوى فيتامين د عند حديثي الولادة في المملكة العربية السعودية ومن ثم مقارنة هذه النتيجة بالمستويات العالمية.

الطريقة: تم فحص مستوى فيتامين د في عينات دم مأخوذة من الحبل السري لحديثي ولادة أصحاء لا تقل أوزانهم عند الولادة عن 2.5 كجم، من أمهات صحيحات في مستشفى الملك خالد الجامعي في عام 2012م، إضافة إلى ذلك جمعت البيانات المتعلقة بحمل الأم والطفل والتي تتضمن: عمر حمل الأم ومقدار تعرضها للشمس أثناء الحمل وكمية استهلاكها للأطعمة الغنية بفيتامين د أثناء الحمل وجنس المولود ووزنه، وكانت النتيجة الأساسية من هذه الدراسة هي نسبة حديثي الولادة الذين يعانون من نقص في فيتامين د (مستوى فيتامين د في الدم أقل من 25 نانومول/لتر). تم تطبيق نموذج الانحدار اللوجستي لإظهار مدى ارتباط نقص فيتامين د عند حديثي الولادة مع تعرض أمهاتهم للشمس أثناء الحمل و استهلاكهن للأطعمة الغنية بفيتامين د.

النتائج: في هذه الدراسة تم سحب عينة دم من الحبل السري لـ 200 مولود، فأظهرت الفحوصات أن 59% منهم كانوا يعانون من نقص في فيتامين د (مستوى فيتامين د أقل من 25 نانومول/لتر)، وأن قرابة 90% من مجموع حديثي الولادة لم يكن لديهم كفاية من فيتامين د (مستوى فيتامين د أقل من 50 نانومول/لتر). لم تظهر الدراسة أي علاقة تربط مستويات فيتامين د عند حديثي الولادة مع مقدار تعرض الأمهات للشمس ولا مع كمية استهلاكهن للأطعمة الغنية بفيتامين د.

خاتمة: أظهرت هذه الدراسة أن المملكة العربية السعودية مثل معظم دول المنطقة تعاني من انتشار نقص فيتامين د عند حديثي الولادة ولذلك فإنه من الضروري تدارك هذه المشكلة عن طريق متابعة مستويات فيتامين د أثناء الحمل ومعالجة النقص إن وجد وكذلك إعطاء كميات كافية من فيتامين د لجميع المواليد.

Objectives: To evaluate vitamin D levels in Saudi newborns utilizing umbilical cord samples, and to benchmark the results with international figures.

Methods: This cross-sectional study was carried out at King Khalid University Hospital, Riyadh, Saudi Arabia between November 2013 and March 2013. Vitamin D levels were assessed in the umbilical cord of healthy term neonates born above 2.5 kg from healthy pregnant mothers. Gestational age (GA), birth weight, gender, levels of sun exposure, and consumption of vitamin D rich food data were collected. Our primary outcome was the percentage of newborns with vitamin D deficiency (vitamin D level below 25 nmol/l). Association of vitamin D deficiency with sun exposure and consumption of vitamin D rich food was tested using a Chi-squared test.

Results: Umbilical samples of 200 newborns were obtained. The average birth weight was 3.2 kg. Deficient vitamin D levels were detected in 59% of the sample. Almost 90% of included newborns had vitamin D levels below 50 nmol/l. We found no association of vitamin D deficiency status to level of sun exposure or to consumption of vitamin D rich food.

Conclusion: Vitamin D deficiency is very common in Saudi newborns at hospital, and is consistent with regional data. Efforts to assess and treat vitamin D deficiency during pregnancy and provide adequate supplementation to newborns are necessary to rectify such a public health concern.

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Vitamin D is essential for bone growth and development. The documented sources of vitamin D are: sunlight's UV radiation, and diet. Although Saudi Arabia is known for its sunny climate throughout the year, recent studies have shown a resurgence of bone diseases.¹⁻³ The early symptoms of vitamin D hypovitaminosis (deficiency and insufficiency) are very vague and hardly noticeable. Hence, this condition progresses slowly in the affected population. Therefore, it goes unnoticed until complications start to develop later in life.¹ Previously, the importance of vitamin D was based on its role in bone mineralization in addition to its role in the regulation of serum phosphate and calcium. Vitamin D deficiency is a common cause of rickets and osteomalacia.⁴ Nowadays, many studies have shown an association of vitamin D deficiency and future infectious/autoimmune illnesses such as lower respiratory tract infections,⁵ diabetes mellitus,⁶ cardiovascular diseases,⁶ and asthma.⁷ While there is no consensus on the levels defining vitamin D deficiency, most studies suggest that values less than 25 nmol/l are indicative of vitamin D deficiency.⁸⁻¹⁰ There are many factors that affect vitamin D levels in the blood. For instance, inadequate sun exposure, consumed diet, malabsorption of vitamin D from the intestine, and some metabolic abnormalities such as chronic renal disorders or hepatic dysfunction are among common factors associated with lower vitamin D levels.¹¹ Recently, obesity was added to the many other factors causing lower vitamin D levels in adult patients.¹² Globally, the status of vitamin D levels in neonates varies widely between different populations. Vitamin D deficiency prevalence among neonates is reported between 50-70%.^{11,13-16} Neonatal vitamin D levels in Saudi Arabia have not been well studied for the last 30 years.¹⁵ The main objective of our study is to evaluate vitamin D levels in Saudi newborns utilizing umbilical cord samples and to benchmark the results to international figures.

Methods. A cross sectional study was conducted at a tertiary university hospital in Riyadh, KSA in the labor and delivery ward. Healthy pregnant Saudi mothers of term newborns above 2.5 kg at birth were recruited.

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Subjects were excluded if they had a history of metabolic bone disease, chronic liver or renal disorders, mothers taking large doses of vitamin D (more than or equal to 1000 IU per day) and infants with major congenital anomalies. Mothers taking routine vitamin supplements during pregnancy (containing 400 IU of vitamin D per day) were not excluded from our study. The study was conducted at King Khalid University Hospital (KKUH) labor and delivery ward between November 1st, 2012 and March 30th, 2013. Subjects were recruited according to the Helsinki declaration principles after signing an informed consent to participate in the study approved by the Institutional Review Board (IRB). To benchmark our results, prior research was identified through searching Medline database from 1960-2013.

The hospital provides free health care to all Saudis. The majority of patients cared for come from low and middle socioeconomic groups. Therefore, it is only fair to assume the majority of the recruited mothers in the study came from low and middle socioeconomic groups.

The following measurements were obtained from the newborn's medical record: gender, birth weight, gestational age, and 25-OH vitamin D levels. One of the co-investigators approached the mother to obtain maternal information: age, parity, gestational age, sun light exposure status, and consumption of vitamin D rich food. Maternal information was double checked from their medical records.

Sample size was calculated based on recently published data of vitamin D levels in Saudi females visiting primary health care clinics. Prevalence of vitamin D deficiency was reported to affect 90% of the enrolled sample.¹⁷ Assuming 85% prevalence in our sample with a 5% precision, around 200 subjects were needed to be recruited in the current study.

We defined mothers with positive sunlight exposure as those with partial body exposure to the sun of at least twice or more per week, for a period of 15-30 minutes. This has been suggested by researchers all around the world to be the bare minimum adequate sunlight exposure.^{16,18} Mothers whose daily diet had ample amount of at least one natural source of vitamin D were considered having sufficient dietary vitamin D. Dietary sources asked about included: fortified milk and dairy products, mushrooms, fish, and certain fish oils.

With the use of a fine needle, 2 ml of blood was drawn from the umbilical vein and stored in test tubes containing separating gel (Li-heprin and K3-EDTA). Blood samples were directly sent to the laboratory unit by the pneumatic tube system (Swiss log). After being centrifuged and separated into plasma, blood samples were stored at -20°C refrigerators until analysis. The

25-OH vitamin D levels were analyzed using electrochemi-luminescence immunoassay technique (Elecys and cobas e-602 immunoassay analyzers, Hitachi, Tokyo, Japan).

Statistical analysis. Umbilical cord 25-OH vitamin D levels of less than 25 nmol/L were considered deficient.^{11,13,18,19} Levels between 25-50 nmol/L were considered insufficient and levels above 50 nmol/L were considered normal. Statistical Product and Service Solutions (SPSS) for windows (version 19.0) was utilized for statistical analysis. Data was presented as means and standard deviation (SD) for normally distributed data. Median and interquartile range (IQR) were utilized for skewed data. Categorical data were presented as percentages. Association of vitamin D deficiency status (<25 nmol/L) and sunlight exposure or dietary status of the mother were tested using Chi-squared test. A *p*-value of 0.05 or less was considered significant.

Results. Two hundred mothers were recruited during the study period. Included subjects had a mean age of 29 (± SD) and were 39 weeks pregnant (± SD). The mean birth weight of included infants was 3.2 kg (± SD), 52% of who were males. Approximately 20% of included mothers indicated positive sun exposure as defined in our study. Almost 70% of them consumed vitamin D rich food on a daily basis as shown in Table 1.

Fifty-nine percent of our included sample had deficient vitamin D levels of less than 25 nmol/l. Twenty-

eight percent had insufficient levels at 25-50 nmol/l. Almost 90% of our included sample had levels below 50 nmol/l. The median vitamin D level for our sample was 21 (IQR 13, 36) as shown in Table 2 & Figure 1. We found no significant association of vitamin D deficiency status and reported sun exposure status (*p*-value 1) or consumption of vitamin D rich food (*p*-value 0.078).

Discussion. Vitamin D deficiency remains a significant and very prevalent health concern in Saudi newborns. Our data is consistent with the published literature in Saudi, 30 years ago at which 68% enrolled neonates had vitamin D levels below 25 nmol/L.¹⁵ Our results are consistent with other regional reports; in Kuwait, for example, 69.7% of the 214 infants that were recruited in a study in 2005 had 25 OH vitamin D level of less than 25 nmol/L. In Iran, studies have revealed even a higher number where 80% of the newborns had 25 OH vitamin D level of less than 25 nmol/L. Different studies around the world have demonstrated that vitamin D deficiency is a global concern.²⁰ Consensus has been reached in defining vitamin D deficiency and insufficiency in adults by many organizations around the world.^{17,21} However, no consensus has been reached to define vitamin D deficiency and insufficiency in the pediatric age group.^{22,23} Nevertheless, recent data suggest that 25-OH vitamin D level of less than 25 nmol/L is classified under severe deficiency, and considered a major risk for developing vitamin D related diseases later in life.

The high prevalence of vitamin D deficiency in the neonatal age group is consistent with the increased incidence of rickets in the country.^{1,2} The high prevalence of vitamin D deficiency reflects the

Table 1 - Baseline characteristics of 200 enrolled mothers and their infants.

Variable	Result	Mean	Median
Age	29	6	
Gestational age	39	1	
Gravida	2		1, 4*
Para	1		0, 3*
Birth weight	3.2 kg	0.5	
Gender (%)			
Male	52		
Sunlight exposure (%)			
Yes	19.5		
Vitamin D rich food consumption (%)			
Yes	69.5		

*IQR - interquartile range

Table 2 - Umbilical Vitamin D levels among participants.

Vitamin D levels	n (%)
Normal (≥50)	25 (12.5)
Insufficient (25-50)	56 (28.0)
Deficient (<25)	119 (59.5)

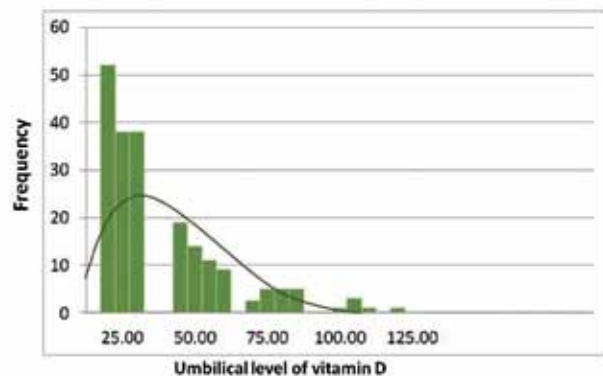


Figure 1 - Umbilical cord vitamin D level distribution among subjects. The curve shows positive skewness. The median is 21 nmol/l with interquartile range.^{13,36}

poor vitamin D status of pregnant mothers as it was established that deficient babies are born to deficient mothers.¹⁷ Moreover, several studies have demonstrated the strong positive relationship between maternal serum levels of vitamin D and umbilical cord blood vitamin D levels.^{24,25} This raises the issue of the poor maternal or prenatal care in respect to vitamin D. Among the recruited mothers, very few have had multivitamin supplements and compliance to these supplements was not assessed. Several studies have demonstrated that vitamin D supplements for the pregnant mothers with doses exceeding 1000 IU per day are necessary to achieve optimal levels and ensure the safety of their infants from developing vitamin D deficiency or its sequelae later in life.²⁹⁻³¹ Unfortunately, in Saudi Arabia, there is no standard policy that mandates physicians to prescribe vitamin D supplements to pregnant mothers nor to assess vitamin D levels as a routine screening test early in pregnancy.

Vitamin D deficiency in newborns sets the stage for further deficiency in early infancy and childhood since most newborns including formula fed infants do not get enough vitamin D dietary recommended intake until around 3 months of age in addition to the lack of sun exposure. The concern is magnified when infants are exclusively breast-fed.³⁴ The American Academy of Pediatrics (AAP) recommends a daily dose of 400 IU for all breast and formula fed infants as studies have shown that supplements of 400 IU of vitamin D for exclusively breast-fed infants raise vitamin D levels above 50 nmol/L.³⁴

Maternal risk factors for developing vitamin D deficiency include absence of sunlight exposure and vegetarian eating habits. Those two factors do not seem to be a problem as the country is known for its all year round sunny weather and eating habits that comprises all kinds of meats and dairy products. However, concealing clothes for women in the country can limit the actual amount of UV light utilized in the skin. Moreover, studies have shown that sunlight quality can vary between seasons as the availability of UV light can be reduced by many factors like the presence of dust (which is a very common weather phenomenon in the region) or clouds.³⁵ So in order to reduce vitamin D deficiency in neonates and its overall impact, we recommend the following preventive measures: to emphasize on AAP recommendation for a daily 400 IU of vitamin D to all infants, to assess vitamin D as a routine screening test in all pregnancies, and supplement pregnant women who are deficient.

Study limitations. Data with regard to the socioeconomic status, skin color, the degree of skin

cover through wearing the veil or “abaya” were not obtained. The data with regard to the degree of sun exposure could not be objectively assessed. Our data represents a tertiary health care center and could not be generalized to the national level.

Future research should focus on the benefits of vitamin D supplementation for pregnant women and their infants and its impact on future health.

In conclusion, vitamin D deficiency is very common in Saudi newborns and is consistent with regional data. Efforts to assess and treat vitamin D deficiency during pregnancy and provide adequate supplementation to newborns are necessary to rectify such a serious public health concern.

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Related Articles

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