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Effect of Maternal Vitamin D and Serum Calcium Levels on Mode of Delivery

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Abstract

Vitamin D deficiency is common in pregnant women. It plays an important role in calcium metabolism as well. There are inconsistent findings as to whether vitamin D and calcium levels affect the mode of delivery, whether vaginal, instrumental or operative. We designed a retrospective cohort study reviewing women who delivered in King Hamad University Hospital (KHUH) in the Kingdom of Bahrain from January 2021 until July 2021 to establish whether there is a relationship. 103 women were included in this study. We found no statistically significant relationship between vitamin D and calcium levels and the mode of delivery. Further studies with a larger sample size are warranted to determine the relationship between vitamin D and calcium levels and the mode of delivery. The role of vitamin D and calcium supplementation at improving pregnancy outcomes also needs to be determined.

Keywords: *vitamin D; serum calcium; Cesarean section; vitamin D deficiency; maternal health; vacuum delivery; mode of delivery.*

Abbreviations

CS: Cesarean section; IQR: inter-quartile range; IRB: Institutional Review Board; IU: International units; KHUH: King Hamad University Hospital; SPSS: Statistical Package for Social Science; SVD: standard vaginal delivery; vitD: vitamin D.

Introduction

Vitamin-D (vitD) is an essential nutrient that is required for bone growth, mineral metabolism, calcium homeostasis, and cell functioning [1]. It is responsible for calcium and phosphorous absorption from the gut and resorption of calcium from the bone to maintain calcium and phosphorous homeostasis and bone mineralization [2]. Therefore, an important role of vitD is calcium absorption [3]. Calcium can be received directly from food sources and dietary supplements. Dietary calcium intake and absorption is essential to provide and maintain sufficient body stores of calcium [4].

VitD deficiency, or low levels of vitD, can be found in chronic conditions such as multiple sclerosis, depression, tuberculosis, and human immune deficiency virus infection [5]. The reported prevalence of vitD deficiency in exclusively breastfed infants ranges from 27% to 82% [6]. The vitD stores in an infant at birth depend on maternal vitD status during pregnancy through transplacental transfer of vitD in the form of 25(OH)D [7]. Hence, pregnant women are considered at a high risk of vit D deficiency [8]. In fact, the prevalence of clinical and subclinical vitD deficiency is higher in pregnant women [9]. As a result, children with minimal exposure to vitD are at a higher risk of developing health problems [8]. In

addition, calcium actively crosses the placenta from the mother to the fetus during the third trimester of pregnancy [10].

A study conducted in Saudi Arabia with a sample size of 1000 participants concluded that vitD deficiency has no effect on the risk of adverse pregnancy and birth outcomes [11]. However, another study by Sabour et al found significant correlations in adequate maternal calcium and vitD levels in pregnancy and positive birth outcomes [9].Interestingly, a systematic review by Pérez-López et al. reported that first-trimester maternal vitD levels were similar in women who then delivered vaginally or through Cesarean section (CS). However, low maternal vitD levels are associated with higher CS rates [12, 16].

We aim to establish whether maternal vitD and calcium levels affect the mode of delivery which can either be standard vaginal delivery (SVD), vacuum delivery, or CS.

Methods

We designed a single-center retrospective cohort study in King Hamad University Hospital (KHUH). We included all patients aged 18-45 years with a singleton pregnancy who delivered in KHUH at term (gestational period of 37 weeks 0 days and above) from January 2021 to July 2021. Patients were excluded from this study if they are known to have a history of hypertension, diabetes mellitus, thyroid disease, parathyroid, renal, or liver disease. In addition, women who underwent multiple Cesarean sections were excluded due to the strong causal relationship between primary and repeated cesarean sections.

A total of 103 patients met the inclusion criteria. The data was collected retrospectively from the hospital's medical records and this included lab results of serum 25-hydroxyvitamin D and serum calcium before delivery and the mode of delivery. Patients remained anonymized and the data was protected safely and entered on a password locked computer. Informed consent was obtained from each patient before enrollment in the study. This study obtained ethical approval from the Institutional Review Board (IRB) at KHUH.

The data was analyzed using the Statistical Package for Social Science (SPSS version 25.0). The modes of delivery were categorized as: SVD, vacuum delivery or CS. In KHUH, vitD is measured in ng/mL and calcium is measured in mmol/L. Descriptive statistics were used to compute the frequencies, median values, and inter-quartile range (IQR). Additionally, the Kruskal-Wallis test was performed to assess the difference between the continuous scores. A *p* value of less than 0.05 was deemed significant.

Results

Vaginal delivery was the most common mode of delivery among the participants (84, 81.5%, p = 0.000). There were only 17 (16.5%) cases of CS among the participants and only 2 patients who had a vacuum delivery (Figure 1).

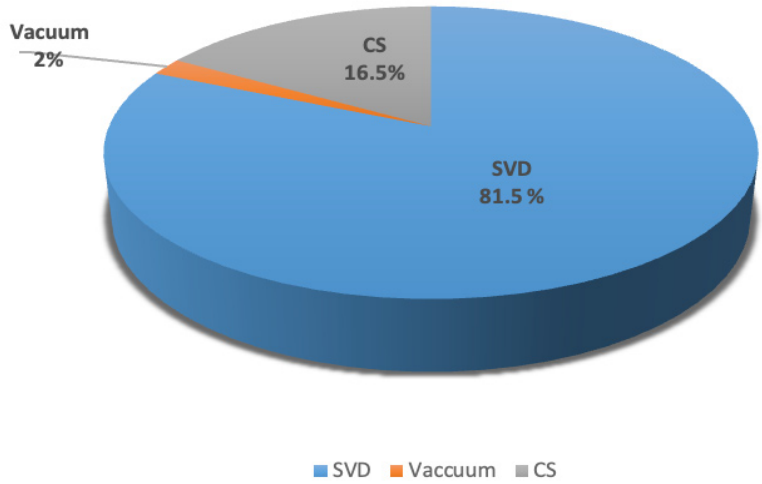

Figure1. *Frequency distribution: Mode of delivery*

Participants who delivered vaginally had a median vitD level of 11.8 ng/mL (IQR 8.7- 17.7). Patients who underwent CS had vitD levels of 11.2 ng/mL (IQR 9-15.6). Similarly, levels of calcium for the participants who delivered vaginally was 2.2 mmol/L (IQR 2.1- 2.3) and that for CS was 2.2 mmol/L (IQR 2.2- 2.4). Vacuum delivery represented a smaller sample size, however, the vitD levels were 16.2 ng/mL (IQR 13.7-18.6) and calcium levels were 2.3 mmol/L (IQR 2.2-2.4) (Table 1 and Figure 2). There was no statistically significant association between the mode of delivery and vitD and calcium levels (Table 1).

Table1. *Vitamin D and Calcium Levels and Mode of Delivery*

Mode of Delivery	SVD		CS		Vacuum		P-value
	Median	IQR	Median	IQR	Median	IQR	
Vitamin D	11.8	8.7- 17.7	11.2	9- 15.6	16.2	13.7- 18.6	0.60
Calcium	2.2	2.1- 2.3	2.2	2.1- 2.3	2.3	2.2- 2.4	0.67

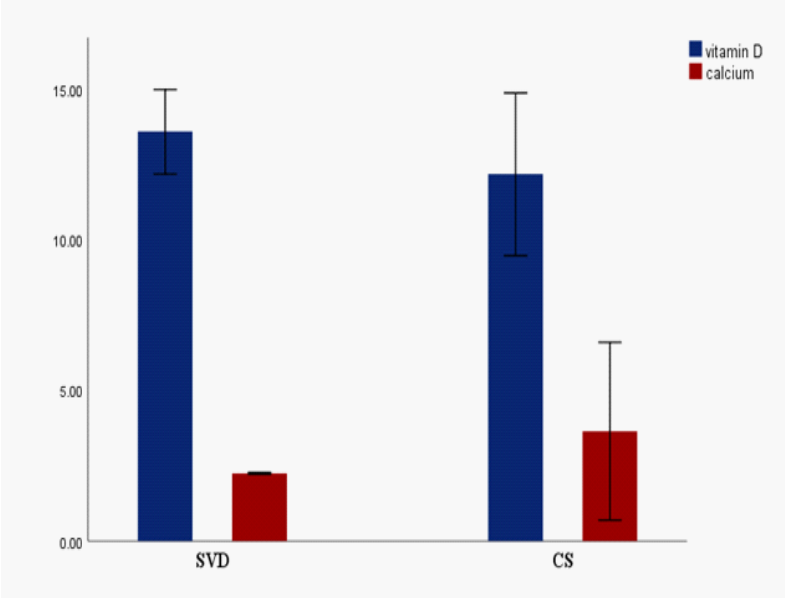

Figure2. *Bar graph demonstrating Vitamin D and Calcium levels for SVD and CS*

Discussion

This study aimed to assess the relationship between vitD and calcium levels on the mode of delivery, however, we failed to establish an association. We did not take into consideration any possible vitD or calcium supplementation during pregnancy and whether that influenced the mode of delivery.

Although we found that vitD levels of those with vacuum delivery was higher than those who underwent SVD or CS, we cannot guarantee those findings due to the low sample size (p=0.6). Furthermore, we found that calcium levels were within the same range in all three modes of delivery ranging between 2.1 and 2.4 mmol/L. This is comparable to a study conducted in Mosul where the calcium levels of the women in the third trimester ranged from 2.07 to 2.12 [13]. The reference range for serum measured total calcium is 2.1-2.8 mmol/L [14]. Therefore, calcium levels of our patients in their third trimester were within the reference range.

Mere wood et al. found that women with severe vitD deficiency were 4 times more likely to deliver through CS than those with adequate vitD levels and those with the highest serum vitD levels had the lowest chance of undergoing CS [1].

Supplementation of vitD in pregnancy improves neonatal metabolism of calcium and weight gain [9]. The appropriate dosage for supplementation is 400 international units (IU) per day and increased to 1000 IU per day in the third trimester [9]. Up to 4000 IU

of vitD per day is reported safe during pregnancy [5, 12].Sabour et al. found a significant association between the supplementation of vitD and calcium and appropriate birth weight [9]. Birth weights are higher in women who received vitD supplementation [12]. On the contrary, Lee et al. found that 50% of mothers and 65% of neonates had severe vitD deficiency at the time of birth even if the mother was taking 400 IU vitD supplements [15]. VitD supplementation is known to lower the risk of pre-eclampsia, maternal infections and preterm delivery. Although measuring vitD during pregnancy may not be routine, it should be encouraged to reduce the risk of vitD deficiency associated conditions [16].

In order to fully validate whether vitD and calcium levels truly affect the mode of delivery, further studies are warranted with a larger sample size. In our study, we were limited by a small sample size which could explain why our conclusions were statistically insignificant. Additionally, further studies need to explore the effect of vitD and/or calcium supplementation during pregnancy on the mode of delivery. Increasing awareness of pregnant women on the importance of sufficient vitD and calcium levels for pregnancy and even while breastfeeding is crucial.

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