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Vitamin D deficiency in mothers, neonates and children

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ABSTRACT

Vitamin D is produced in response to the exposure of skin to sunlight through UV-B synthesis. It can also be obtained from diet and dietary supplements. Vitamin D is essential for strong bones as it helps to absorb calcium from diet. Vitamin D deficiency mainly occurs if strict vegetarian diet is followed as mostly the source of vitamin D is animal based; therefore, exposure to sunlight is restricted or having dark skin color. Low vitamin D levels results in increased possibility of gestational diabetes among pregnant women, low birth weight and pre-eclampsia in infants, and mothers may suffer bone impairment, osteoporosis, hypocalcaemia, and hypertension. Vitamin D deficiency is directly linked with severe complication in mothers and neonates, causing rickets, poor fetal growth and infantile eczema in neonates. Higher prevalence rate of vitamin D deficiency has led professionals to emphasize on development of relevant precautionary measures.

1. Introduction

Vitamin D deficiency has been identified as a major public health issue, which is continuously increasing at a constant rate across the globe. Vitamin D is derived through UV-B-induced synthesis in the skin; however, the environmental factors along with the obsolete lifestyles often limit the exposure of sunlight. Limited exposure to the sunlight along with sedentary lifestyle usually results in the increased prevalence of vitamin D deficiency. Moreover, there are a significant number of orthopaedic complications, which usually affects the wellbeing of patients. Vitamin D deficiency has diversified adverse effects in mothers, neonates, and children.

It is a fact that low mineral vitamin D status during pregnancy is directly associated with accumulated adverse effects. It has been identified that lower vitamin D level has been linked to depression [1], breast cancer [2], type 2 diabetes [3,4], type 1 diabetes [5], cardio-vascular diseases [6], auto-immune diseases [7], infections [8] and autism [9]; although, most of these associations are still under active research. Moreover, inadequate vitamin D deficiency among mothers may result in bone impairment, osteoporosis, hypocalcaemia, preeclampsia, preterm birth, and hypertension. Other studies mentioned that pregnant women with low 25(OHD) levels had an increased risk of gestational diabetes, pre-eclampsia, small for gestational age infants and low birth weight infants but no association with delivery by caesarean section [10]. Similarly, neonates are at excessive risk of poor fetal growth, rickets, and infantile eczema due to deficiency of vitamin D. Furthermore, children may also suffer from severe hypocalcaemia, rickets, and other orthopaedic complications. Therefore, it is said that adequate vitamin D status is healthier for mothers, neonates, and children to regulate their body processes effectively. Increased prevalence rate of vitamin D deficiency has led the scientists and other professionals to focus on the development of precautionary measures. Therefore, many studies have been carried out to assure the wellbeing of patients, suffering from inadequate levels of vitamin D. There are several dietary sources to overcome the vitamin D deficiency along with its serving is shown in Table 1.

Specifically, the core focus of the previously published studies has been made on the deficiency and its prevention among general population. Although, the studies have been conducted by considering mothers, neonates, and children; however, no any study has gathered these three population segments for identifying adverse effects of vitamin D deficiency. Thus, this study has aimed to evaluate the adverse effects of vitamin D deficiency among mothers, neonates, and children collectively. Moreover, certain precautionary measures will be also recommended to this population to address their complexities accordingly.

The review has aimed to retrieve necessary data in regards of vitamin D deficiency among mothers, neonates, and children, which is necessary to be evaluated for better precautionary

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Table 1
Dietary sources.

Nutritional Sources of vitamin D		
Food	Serving	Content of Vit D
Cod liver oil	1 tablespoon	360 IU
Salmon, Cooked	100gram	345 (IU)
Mackerel, cooked	100 g	345 (IU)
Sardines, canned in oil	50 g	250 (IU)
Tuna Fish, canned in oil	85 g	200 (IU)
Egg (Vitamin D is in egg yolk)	1 whole	20(IU)
Milk, non-fat, Vitamin D fortified	1 cup	98(IU)

measures. In this review, information about vitamin D sources has been presented along with the definition of vitamin D deficiency/insufficiency and its epidemiological prevalence focusing on the Gulf region. In addition to that, the importance of vitamin D to the health of pregnant women, their neonates, and their children later in life has been also presented. This review has also focused on two important issues related to vitamin D deficiency, which mainly include prenatal outcome and the metabolic bone disease in preterm infants. Moreover, the review has also utilized compounded interventions for analyzing its significance in reducing the complexities of vitamin D deficiency. Thus, the review has scrutinized enormous resources for presenting valuable information on the basis of deficiency and approaches to improvise levels of vitamin D in body.

2. Methodology

Qualitative research has been employed for carrying out the review on the basis of previously published literature. A systematic approach has been developed for the assessment of data in regards of vitamin D deficiency among mothers, neonates, and children. The review has mainly considered reliable resources for retrieving data for the last 10 years. The analysis of the collected data has been done in accordance with the standardized principles of systematic review. Thematic and content analysis approaches have been also utilized for the review of literature on the basis of identified variables. Therefore, effective methodological aspects have been utilized for assessing and analyzing collected data.

3. Results and discussion

3.1. Vitamin D sources

Sources of vitamin D for human body include dietary intake and sunlight. Regardless of the sources, it is transported to the liver for conversion to 25-hydroxyvitamin D 25(OHD), a main circulating and storage form. 25(OHD) is transported to the kidneys where it is converted to the active form of vitamin D, which is 1, 25-dihydroxyvitamin D (1, 25$(OH)_2$ D), a process that is tightly regulated by parathyroid hormone (PTH). The best assessment of vitamin D level in the human body, is estimation of 25(OHD) in the blood [11]. Sunlight exposure often has a major influence on vitamin D level in human body. The effects of exposure to sunlight are profoundly dependent upon skin color, latitudes, seasons, use of sun-block, and cultural practices. While sunlight is a major potential source for vitamin D, the American Academy of Pediatrics (AAP) always advises to keep infants out of direct sunlight and to have them wear protective clothing, which usually leads to lack of sun exposure in this age group and eventually to vitamin D deficiency [12]. Lack of sunlight exposure, knowing that breast milk is relatively a poor source of vitamin D, increases the reliance on dietary sources of vitamin D plus supplementation for infants and children. Maternal 25(OHD) is assumed to freely cross the human placenta [13], maternal vitamin D status during pregnancy is important for vitamin D of the child not only in the neonatal period but also it extends to early infancy [13,14].

3.2. Definition of vitamin D deficiency and insufficiency

Vitamin D deficiency has been defined as a 25(OHD) level less than 20 mg/ml (50 nmol/l) while vitamin D insufficiency is defined as a 25(OHD) level between 21 and 29 ng/ml (52–72 nmol/l). It is a fact that vitamin D deficiency varies by age group; therefore, there are certain controversies in regards of the standardized level for identifying deficiencies. For this purpose, symptomatic approach is widely used for assessing the insufficiency of vitamin D [15,16]. The vitamin D deficiency has been studied and its global prevalence rate is summarized in Table 2.

3.3. Epidemiology of vitamin D deficiency

Globally, it is estimated that a significant number of people may be affected either by vitamin D deficiency or insufficiency [16]. Vitamin D insufficiency is observed in up to 60% of Caucasian women [17] and the rate among women with dark skin is estimated to be higher [18]. Even in areas with abundant sunshine, vitamin D insufficiency or deficiency is extremely common among women. For instance, substantial proportions of pregnant women reportedly were vitamin D deficient in Ethiopia (80%) and India (66%) [19]. It is anticipated that vitamin D deficiency is more common in countries where head covering and spending more time indoor is common like the Gulf region [20]. In Kuwait, 40% of mothers and 60% of their offspring were found vitamin D deficient on the day of delivery [21]; while earlier study from Kuwait reported more than 75% of pregnant women and approximately 90% of their newborn infants had 25(OHD) level less than 20 ng/ml [22]. In Qatar, 48% of pregnant women were reported to have vitamin D deficiency [23]. In UAE, Dawodu et al. [24] demonstrated low serum vitamin D levels among mothers and their breast fed infants. The results provided justification for vitamin D supplementation of breast-feeding infants and mothers in UAE [24].

3.4. Health outcomes in the perinatal and childhood period

In addition to its well-defined classical functions related to calcium homeostasis and bone development, emerging evidence suggested that adequate vitamin D status could play an important role in other aspects of health. Lower vitamin D level has been linked to depression [1], breast cancer [2], type 2 diabetes [3,4],

Table 2
Global prevalence of vitamin D deficiency [45,44].

Country	Age	Sex	Number of Participants	Mean 25(OH) Vitamin D
Sweden	71	Male	1194	68.7
France	35–65	Male + Female	1569	61
Italy	65+	Male + Female	1006	39.9
Switzerland	25–74	Male + Female	3276	50
Saudi Arabia	20–74	Male + Female	510	32.6

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