Research Article

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Vitamin D deficiency during pregnancy in Turkey and the effect of the sunlight: a systematic review and meta-analysis

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Abstract

Objectives: vitamin D deficiency is a common and important problem during pregnancy. vitamin D deficiency in pregnancy can cause serious health problems for both mother and fetus. The aim of this study was to systematically review the literature for studies that assessed vitamin D status during pregnancy in the Turkey and affects of the sunlight on Vitamin D deficiency.

Methods: We conducted a systematic review and meta-analysis focused on vitamin D deficiency among pregnancy. PubMed, Scopus, Web of Science and Turkey citation index databases were searched between January 2010 and October 2019 was undertaken using keywords for ‘Vitamin D deficiency’ and ‘Pregnancy’ and ‘Turkey’ with English language restrictions imposed.

Results: A total of 66 studies were identified; 14 were included in the review. The prevalence of vitamin D deficiency in pregnancy was 83%, including all studies regardless of time in Turkey. When evaluated seasonal period, the prevalence of vitamin D deficiency was 73% in pregnant women in the sunny period, while it was 90% in the less sunny period.

Conclusions: The prevalence of vitamin D deficiency is high in pregnancy and is a major public health problem in Turkey. Turkey specific strategies should be developed for reducing vitamin D deficiency prevalence by investigation of risk factors and protective factors of vitamin D deficiency.

Introduction

Vitamin D (Vit-D) is essential for calcium and bone metabolism, hormone secretion, immune function, cell renewal and differentiation [1]. A small part of the vitamin D that people need is obtained from food. Most of the vitamin D source in humans is obtained from sunlight (90%) and a small portion is obtained from food (10%) [2]. Therefore, exposure to sunlight may provide protection against hypovitaminosis D.

Serum 25-hydroxy-D concentration below 20 ng/dL is defined as a Vit-D deficiency [3]. Vit-D deficiency is common worldwide and is a serious public health problem. It is known that the prevalence of Vit-D deficiency is even higher among pregnant women. Vit-D deficiency may cause many disorders on the general population such as impaired immune function, cancer susceptibility, cardiovascular disease, diabetes, rheumatic disease, muscle weakness, chronic pain and neuropsychiatric dysfunction [4–6]. Despite many negative effects in the general population, Vit-D deficiency during pregnancy is a more serious problem. The reason that makes Vit-D deficiency important during pregnancy is that it has negative effects on calcium metabolism of both neonatal and maternal. Therewithal, Vit-D deficiency during pregnancy has been associated with infantile rickets and poor fetal and neonatal growth and development [7, 8]. In addition, adverse effects such as gestational diabetes, preterm birth, low birth weight, cesarean-section and preeclampsia have been reported on the maternal health [9].

Although the negative effects on the maternal and fetal health are known, unfortunately, Vit-D deficiency still has a high prevalence. Maternal Vit-D deficiency prevalence among pregnant women ranges from 20 to 85% [10]. Gür et al. [11] reported that deficiency of vitamin D during pregnancy is 27.8 and 76.3% in two different regions in

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Turkey [11]. In the literature, many studies investigated vitamin D levels among pregnant women in different time frames and different regions of Turkey. As far as we know, there have been no studies on Vit-D deficiency in literature which is to reflect the overall data of Turkey.

This current study aimed to assign the prevalence of Vit-D deficiency during pregnancy in Turkey by review the studies on vitamin D levels during pregnancy in the literature. Sunlight has an important role in vitamin D synthesis, so another aim of the study is to assess the effect of the seasonal period (sunlight) on Vit-D deficiency prevalence.

Material and methods

This current systematic review study was guided following the Cochrane Collaboration methodology for systematic reviews and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) reporting guidelines [12, 13].

Search strategy and study selection

In 2010, Family Medicine practices started in our country and pregnant follow-up were started to be performed regularly by family physicians. In order to prevent Vit-D deficiency in our country, a vitamin D support program was started in 2011 for pregnant women [14]. Therefore, a systematic review was conducted between January 2010 and October 2019 to determine the articles on vitamin D status in our country. To identify eligible studies, PubMed, Scopus, Web of Science and Turkey citation index databases were searched for studies published between January 2010 and October 2019. The following search string was used in database: ('Vit-D deficiency' [MeSH] and 'Pregnancy' [MeSH] and 'Turkey' [MeSH]).

In the studies conducted in Turkey, the measurement time of vitamin D was divided into two as sunny (summer) and less sunny (winter) periods. Between November and April, except for April, six months were considered as less sunny (winter) days, while between April and November, except for November, six months were considered as sunny (summer) days. In our systematic review, we evaluated the prevalence of Vit-D deficiency separately according to the studies conducted on both sunny and less sunny days. We evaluated all studies independently of time to establish the prevalence of Vit-D deficiency during pregnancy in Turkey.

The search strategy and study selection process was terminated by examining the summary sections of the articles in four databases that measured vitamin D during pregnancy period and selecting the articles that match the research criteria.

Eligibility criteria

In this current meta-analysis study, research articles containing original data that reported the prevalence of Vit-D deficiency or reported serum 25 (OH) D levels measured during pregnancy were included. Serum 25 (OH) D3 measurement is recommended to

evaluate vitamin D levels. Serum 25 (OH) D3 level <20 ng/mL in children and adults has been reported as vitamin D deficiency [3]. In our systematic analysis, studies referring the 25 (OH) D3 level defined for Vit-D deficiency as <20 ng/mL were included. Another inclusion criterion is that blood samples were taken from pregnant women and blood sampling time was specified. Literature review was conducted in English and only the articles published in English were included in our systematic analysis. Articles with only abstracts and articles other than research (original) articles were not included in the study. Studies with different diagnostic value of Vit-D deficiency, measurement time of vitamin D not specified, case reports or series, reviews, validation studies, letters, editorials or qualitative studies were excluded.

Data extraction and management

We used a data obtaining form to collect key indicators of each study, type of the studies, the 25 (OH) D cut-off point, the 25 (OH) D measurement method, blood sampling seasonal period and the criteria for blood sampling during pregnancy. Articles were categorized on the basis of the outcomes of Vit-D deficiency during pregnancy in Turkey. Any differences in the extraction and interpretation of data were resolved by discussion between two the researchers.

Data synthesis

We recorded the data obtained from the articles that meet our inclusion criteria on the data collection form. The total number of participants and the number of participants with 25 (OH) D level <20 ng/dL described in the results section of the studies were recorded in the table. Percent of Vit-D deficiency prevalence was calculated from obtained numbers. Articles which are the total number of participants, number of participants below 25 (OH) D level <20 ng/dL and 25 (OH) D cut-off value unknown or different from 20 ng/dL cut-off point were excluded.

Statistical analysis

The publication bias of the studies was examined before the meta-analysis. The heterogeneity of the studies was evaluated with the Cochran Q test. If heterogeneity was determined with the Cochran Q test, then "Random intercept logistic regression model" was performed using the random effects model. For statistical analysis, "meta" package and "metaprop" function were used in R-Studio (Version 1.2.5019 with R version 3.6.1) statistical package.

Result

We obtained 66 publications or abstract in first screening. As a result of the article selection procedure, 14 original research articles that meet the study criteria were included in our meta-analysis study (Table 1).

In our country, the time period between November and April was evaluated as less sunny (winter) period. Of the 14 studies that met our study criteria, seven studies were

Table 1: Article selection flow diagram.

conducted between sunny periods and seven studies were conducted between less sunny periods. Seven studies which are evaluating Vit-D deficiency during pregnancy were performed in sunny periods [15–20]. Cochran Q test showed heterogeneity among studies ($p < 0.001$; $I^2 = 97.5\%$). The meta-analysis results of the studies presenting Vit-D deficiency in the summer period were given by Forest Plot in Table 2. The prevalence of Vit-D deficiency was found to be 73% in sunny periods (Table 2).

Seven studies which are evaluating Vit-D deficiency during pregnancy were performed in less sunny periods [21–27]. Cochran Q test showed heterogeneity among studies ($p < 0.001$; $I^2 = 96.6\%$). The meta-analysis results of the studies presenting Vit-D deficiency in less sunny periods were given by Forest Plot in Table 3. The prevalence of Vit-D deficiency was found to be 90% in less sunny periods (Table 3).

Cochran Q test showed heterogeneity among studies ($p < 0.001$; $I^2 = 97.7\%$). The meta-analysis results of the studies presenting Vit-D deficiency in all studies regardless of time in

Turkey were given by Forest Plot in Table 4 [19–27]. The prevalence of Vit-D deficiency in pregnancy was 83%, including all studies regardless of time in Turkey (Table 4).

Discussion

This current study provides an updated overview of Vit-D deficiency during pregnancy in Turkey. The prevalence of Vit-D deficiency in pregnant women was 83% considering independent from sunlight. Palacios et al. [28] reported that the prevalence of Vit-D deficiency during pregnancy was 90% in 2014 in Turkey [28]. Our data were similar to those of Palacios et al. Vit-D prophylaxis is recommended to all pregnant women during pregnancy in Turkey. Free Vit-D preparations are provided to all pregnant women through family physicians in Turkey. Despite Vit-D support programs in Turkey, Vit-D deficiency during pregnancy is still a major public health problem. Palacios et al. [28] reported that prevalence of Vit-D deficiency during

Table 2: Deficiency of vitamin D during pregnancy in sunny (summer) period. **Table 3:** Deficiency of vitamin D during pregnancy in less sunny (winter) period.

Table 4: Prevalence of Vit-D deficiency during pregnancy in Turkey.

pregnancy as 44, 24, 33 and 31% in developed countries such as the Netherlands, Canada, USA and the UK, respectively. In the same study from developing countries such as Pakistan, Iran, and India the prevalence of Vit-D deficiency during pregnancy, respectively 72, 67 and 96% have been reported. Religious beliefs and dressing characteristics are similar in Turkey, Iran, Pakistan and India. Many studies have reported that dressing style is a risk factor for Vit-D deficiency [19, 29, 30]. Dressing style in Islamic countries such as Turkey may be the cause of the common Vit-D deficiency.

Dimopoulos et al. [31] reported that Vit-D deficiency was less common in those who more benefited from sunlight. In many studies have reported that sunlight has a protective effect on Vit-D deficiency [32–35]. In this context, we evaluated Vit-D deficiency in two periods as sunny and relatively less sunny. While the prevalence of Vit-D deficiency measured in sunny period was 73%, the prevalence of Vit-D deficiency measured in less sunny period was 83%. Cakir et al. [36] have reported that vitamin D level during pregnancy in summer time is significantly higher than winter time in Turkey. The major source of vitamin D is known to be sunlight [2]. Coherent with the literature data, it is expected that we will detect less Vit-D deficiency in the sunny period. Health workers can be explaining the important effect of the sun on vitamin D synthesis and

advise patients to benefit from more sunlight. In this way the prevalence of Vit-D deficiency can be reduced. Closed dressing style is one of the most important reasons not enough being able to benefit from sunlight in countries such as Turkey. We have thought that methods should be developed to benefit from sunlight according to countries' lifestyles and religious beliefs.

Limitations

There are several limitations of the present report. Firstly we obtained our data from various articles, which may lead to a lack of standardization in vitamin D measurement. Covered dressing style, which is common in our country, could not be evaluated in our study. Sunlight is an effective factor on the level of vitamin D. Our study data includes many different region data in Turkey. Regional differences can affect vitamin D levels by affecting both sun exposure and dressing style. This present study could not explain the possible effects of regional differences on vitamin D. Another limitation is that we cannot evaluate the use of vitamin D supplements by the participants. Future studies may investigate the relationship between vitamin D use and Vit-D deficiency.

Conclusion

In summary, this systematic review and meta-analysis showed that the prevalence of Vit-D deficiency is high in pregnancy and is a major public health problem in Turkey. Despite prophylaxis of vitamin D in pregnant women, Vit-D deficiency is still a common problem. It was found that the prevalence of Vit-D deficiency was decreased in sunny periods. These data could provide a targeted approach based on population characteristics for future vitamin D supplementation studies and help recognize parameters toward developing a health policy to prevent Vit-D deficiency in Turkey.

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