

# Association Between Vitamin D3 Deficiency and Postpartum Outcomes in Pregnant Women: A Systematic Literature Review and Meta Analysis

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## ABSTRACT

Women may experience postpartum depression, anxiety, and other mood disorders after giving birth. Vitamin D3 can be formed in the human body through skin exposure to sunlight (UV radiation) or from dietary resources. This study aims to evaluate the correlation between postpartum depression and vitamin D3 deficiency in pregnant women using "preferred reporting. Item for systemic review and meta-analysis (PRISMA) framework as a guide, this study incorporated insight from 9 scholarly papers to illuminate the impact of vitamin D3 on pregnant women that is related to postpartum, which can lead to psychological issues like anxiety and depression. In conclusion, a pregnant woman experiencing low levels of vitamin D3 thought that the first and second trimesters of her pregnancy might have an impact on her psychological behavior after giving birth because she did not eat a diet high in vitamin D3 and was not exposed to sunlight. In addition, this study revealed that pregnant women have severely low vitamin D3 levels. Therefore, every pregnant woman should be monitored and followed up with her vitamin D3 serum levels throughout the period of gestation and take vitamin D3 supplements when it is found at a low level and should also visit a psychiatrist when one of these symptoms appears.

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## INTRODUCTION

The human skin produces vitamin D3 when exposed to sunlight, and it may also be found in some foods (such as eggs, cod liver oil, fatty fish, and mushrooms). When comparing PT to non-pregnant women, there is a notable difference in vitamin D3 metabolism, the non-pregnant normal level from this vitamin. The physical and mental health of children after pregnancy has been linked to vitamin D3 insufficiency during gestation in addition to pregnancy outcomes (Palacios et al., 2019). Research has demonstrated that low levels of vitamin D3 in the body during pregnancy are associated with a higher risk of developing certain diseases, both during and after delivery. These diseases include bacterial

vaginosis, preeclampsia, placental insufficiency, premature birth, and increased frequency of cesarean section (Bozorov, et al., 2020). A condition that is frequently incorrectly identified and inadequately managed and that is correlated with mental illness is known as postpartum depression, which affects 10–15% of PT. If her mother does not treat her child's depression, she risks stress and anxiety in her child later in life (Saharoy et al., 2023).

Pregnant women and other women in their families carry a higher genetic risk of PPD (Chau et al., 2023). Woman who gets inadequate therapy for their depression exposure the woman for chronic disease and recurrence. The clinical symptoms of

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PPD include depression, loss of interest, impaired attention, disturbed appetite, excessive sleep or non-existent worry for the baby, persistent exhaustion, and anxiety or irritability. It was started within four weeks of delivery. The recurrence rate is up to 50%, or one in eight new mothers (Silverman et al., 2017). The etiology of PPD remains unclear. Postpartum depression is sometimes thought to be caused by vitamin deficiency. Studies have generally indicated that substantial variations in a woman's vitamin D3 content are more likely to be the cause of PPD than any single reason that has been identified. This study aimed to determine the association between postpartum depression and vitamin D3 in pregnancy. This study treated postpartum depression in pregnant women with four weeks after delivery, which included depression and anxiety through the effect of deficiency or decreases in vitamin D3. This comprehensive investigation serves as a basis for those seeking to treat postpartum depression.

The following research questions were stated to achieve this study objective:

- What is the common instrument device used for estimating the level of vitamin D?

Based on the studies that we analyzed, it was noted that there were three studies out of the total (nine studies) that used high liquid chromatography in the job (Jan Mohamed et al., 2014). On the other hand, also, more studies used chemiluminescence immunoassay techniques, for example (Christoph et al., 2020). The remaining studies used different laboratory instruments to measure the level of vitamin D3 (Williams et al., 2016).

- Where is the geographic distribution used in the articles that link the vitamin D3 associated with PT and postpartum?

As illustrated in the table, there are different site distributions worldwide, such as Malaysia, Michigan, Sweden, Copenhagen, Switzerland, Spain, Denmark, Latvia, and Japan. Studied by Jan Mohamed et al., 2014; Williams et al., 2016. These studies were conducted separately.

- What is the type of study period and number of samples used by the author?

According to these studies, each author used multiple samples and varied the period for sample collection and work; Jan Mohamed et al., (2014) used a Cohort Study in April 2010 to December 2012 and 102 sample PT, whereas Williams et al., (2016) used a secondary analysis of a randomized trial designed in October 2008 and May 2011 with 126 sample PT.

Axelsson et al., (2019) used a descriptive study of 1397 women who underwent PT between 2011 and 2018., 2019 used cohort study not found period for sample collection and 1577 sample PT, Christoph et al., (2020) from 2012 and 2015, 1382 sample PT, Pérez et al., (2020) used cross-sectional study from 2018 to 2019 and 289 sample PT, Vestergaard et al., (2023) no type of study, collection the sample at any time and 2000 sample PT, Meija et al., (2023), from July 2020 to January 2023 and 735 sample PT and Noshiro et al., (2023) from January to June and 2021 and 126 sample PT.

- What is the statistical analysis program and type of test for each article approach?

After reading all the papers, most authors used the SBSS program for analysis of the results; for instance, Axelsson et al., (2019); Pérez et al., (2020); and Meija et al., (2023). Another author used SBSS integrated with other programs, such as ANOVA, as in Jan Mohamed et al., (2014). In addition, some authors used multiple programs for the analysis, the results of such programs (ANOVA and SAS Version 9.3, RStudio version 3.3.0, R version 3.2.2, and statistical software packages by Williams et al., (2016), Schoos et al., (2019), Christoph et al., (2020), and Noshiro et al., (2023).

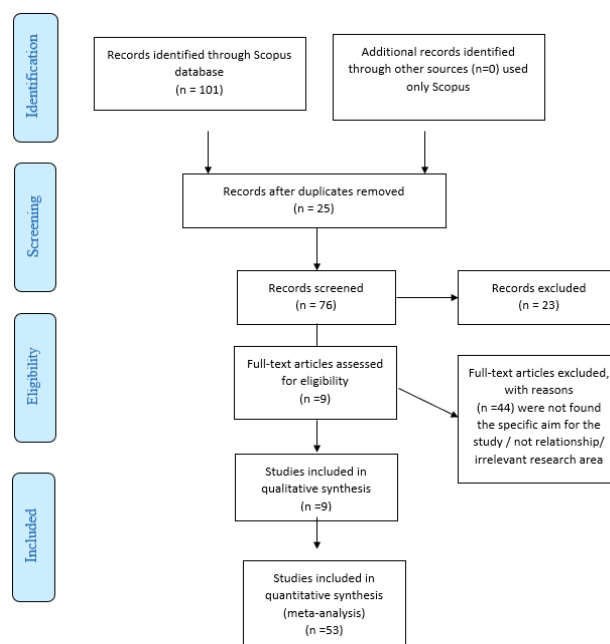
Based on analysis of nine papers, we found that the most article found there are pregnant women suffering from vitamin D3 deficiency for example, in a study performed by Jan Mohamed et al., (2014), we found that most PT are at risk for vitamin D3 deficiency, another study by Axelsson et al., 2019 found that Vitamin D3 deficiency was more common than previously reported in Swedish pregnant women, similar to the article by Christoph et al., (2020), while another study found an association between vitamin D3 deficiency and postpartum as well as depression and stress; for instance, in women at risk for depression, early pregnancy low vitamin D3 levels are associated with higher depressive symptom scores in early and late pregnancy, the frequency of vitamin D3 deficiency in expectant and breastfeeding. studied by Williams et al., (2016) and Vestergaard et al., (2023). While the remaining studies demonstrate that taking a larger dose of vitamin D supplements during pregnancy has positive consequences, this offers a low-cost, readily implementable modification to prenatal care that can enhance the health of mothers and children throughout and beyond pregnancy (Vestergaard et al., 2023). Another study always found in 25(OH)D on its own, significant factors influencing the levels of 25(OH) in the blood through pregnancy and the early years of life by Schoos et al., (2019). The last study found linked

between vitamin d, ketone body and postpartum in PT.

Label	Article	Location	Objective	Methodology (period of work, number of sample)
A1	Jan Mohamed et al., (2014)	Malaysia	By evaluating the amount of 25(OH) in breast milk and mother serum, one may evaluate the suitability of the mother's vitamin D3 status and ascertain the correlation between the two.	Cohort Study (April 2010 to December 2012 and 102 PT)
A2	Williams et al., (2016)	Michigan	Evaluate whether low maternal vitamin D3 levels are associated with depressive symptoms in pregnancy.	secondary analysis of a randomized trial designed (October 2008 and May 2011 and 126 PT)
A3	Axelsson et al., (2019)	Sweden	To determine if a lack of vitamin D3 in laboring pregnant women was linked to a higher risk of postpartum infectious morbidity within eight weeks of giving birth. Estimating the prevalence of vitamin D3 insufficiency in pregnant woman in Linköping, Sweden at the time of birth was secondary goal	Descriptive (from 2011 and 2018 and 1397 women PT)
A4	Schoos et al., (2019)	Copenhagen	To determine the genetic, nutritional and environmental factors that influence the levels of blood 25(OH)D during pregnancy and the early years of life	cohort study not found period for sample collection and 1577 PT
A5	Christoph et al., (2020)	Switzerland	To find out how many PT in our clinic who are getting prenatal care also have vitamin D3 insufficiency	(from 2012 and 2015, 1382 PT)
A6	Pérez et al., (2020)	Spain	To assess the relationship between preterm birth and vitamin D3 insufficiency in the early stages of pregnancy	(cross-sectional study from 2018 to 2019, 289 PT)
A7	Vestergaard et al., (2023)	Denmark	To determine if taking more vitamin D3 supplement during pregnancy lowers the risk of vitamin D3 deficiency and avoid unfavorable pregnancy outcome, with a focus on gestational diabetes, preeclampsia and fetal growth restriction	(no type pf study collection the sample at any time 2000PT)
A8	Meija et al., (2023)	Latvia	To evaluate a PT vitamin D3 levels, parathyroid hormone levels, dietary and supplementary vitamin D3 consumption, and lifestyle variables in order to determine her vitamin D3 status	(From July 2020 to January 2023, 735 PT)
A9	Noshiro et al., (2023)	Japan	The correlation between dietary status throughout pregnancy and after giving birth and PPD	(From January and June 2021, 126 PT)

Statistic and type of test	Type of instrument	Recommendation
IBM SPSS Statistics, Version 19.0 (USA). And ANOVA t-test.	High Performance Liquid Chromatography (HPLC) couple with spectrometer	High percentage of pregnant Malay women are at risk of vitamin D3 insufficiency
ANOVA and SAS Version 9.3 T-Test Fisher's exact test. Mann-Whitney test	Radioimmunoassay	Low vitamin D3 level in the early stage of pregnancy are linked to increased rating of anxiety symptoms in the late stages of pregnancy in women who are at risk for anxiety
SPSS Version 25. chi-squared tests t-tests	CMIA	Compared to earlier reports, vitamin D3 insufficiency was more prevalent in Swedish pregnant women there.
RStudio version 3.3.0.	HPLC couple with spectrometry	At all times, genetics had a significant role in explaining 2%-11 of the variation in 25(OH)D. circulating 25(OH)D levels through pregnancy and early infancy are influenced by dietary variables, environmental factors, and mostly genetics
R, version 3.2.2.	chemiluminescent immunoassays (CMIA)	A mean blood 25(OH)D level of around 37 nmol/L was discovered in pregnant Swiss women. Moreover, one-third of the study group had a serum 25(OH)D level below 25 nmol/l, indicating a severe vitamin D3 deficiency.
SPSS version 25 Kolmogorov-Smirnov test. Pearson's chi-square ( $\chi^2$ ) test Mann-Whitney U test The Spearman correlation test	CMIA	Preterm birth was better predicted by vitamin D3 deficiency, defined as 25-hydroxy vitamin D3 concentration below 20 ng/ml when combined with maternal parathyroid hormone levels above the 80 <sup>th</sup> percentile during the first trimester of pregnancy
Student's t-test chi-square test	high-performance liquid chromatography coupled with tandem mass spectrometry	Larger doses of vitamin D3 supplementation during pregnancy have positive benefits. this will offer a low cost, readily implementable modification to prenatal care that can enhance the health of mother and child through and beyond pregnancy
SPSS version 27.0. graphical methods and Shapiro-Wilk and Levene tests. Mann-Whitney or the Kruskal-Wallis H test The chi square test	CMIA	Vitamin D3 deficiency is common in expectant and new mothers
JMP Pro16© statistical software package (SAS, Cary, NC, USA).	Enzyme-linked immunosorbent assay	This study recommended that besides vitamin D3, tested the ketone levels of a pregnant woman in the second trimester may be used to predict PPD

## METHODOLOGY



### Research Design

This systematic literature review (SLR) follows a structured and rigorous research design to comprehensively synthesize and analyze existing scholarly works. The research process adheres to established guideline for conduct SLR (Moher et al., 2009)

### Identification

#### Database Selection

A systematic search of the relevant literature was conducted in major academic databases, including Scopus. This database provides comprehensive collection of peers \_reviewed articles. relevant to vitamin D3 and pregnant

#### Search Strings

To ensure the retrieval of pertinent studies, a combination of keywords and phrases were used, including “vitamin D3” and “pregnant.” Moreover, more keywords were applied to decrease the result, for instance title-abs-key (association between vitamin D3 and postpartum mood disorders) and pub year > 2012 and pub year < 2024 and limit to (exact keyword “Female”) or limit to (exact keyword, “Pregnancy”) or limit-to (exact keyword “vitamin D”) or limit to (exact keyword , “Pregnant Woman”) or limit to (exact keyword “Postpartum Period”) or limit to (exact keyword “Third Trimester Pregnancy”) or limit to (exact keyword , “Postnatal Depression”) or limit to (exact keyword , “Depression, Postpartum”)

#### Inclusion and Exclusion Criteria

Articles were included if they focus on the integration of vitamin D3 within the pregnant instructional design. Exclusion criteria included studies published before 2023 were excluded. The rearview prioritizes the recent development of vitamin D3 integrated with PT. Moreover, only articles were included; for instance, only two (Doctype, “ar”) articles written in English were considered. For instance, this was applied and limited to (language, “English”).

#### Search Period

The search encompassed 2013 to 2023.

### Screening and Selection

#### Initial Screening

The initial screening involved assessing the titles and abstracts of the retrieved articles for their relevance to the research questions. Irrelevant articles were excluded from analysis. In the initial screening, 101 documents were assessed using the inclusion and exclusion criteria, and the number of articles decreased from 101 to 76 documents. When we started downloading the documents, 23 documents were not retrieved for a few reasons. Such articles were not available for online or free access. A few articles had no DOI/links. Thus, 53 documents were downloaded.

#### Full Text Review

During this phase, each article was assessed for its alignment with the research questions and the inclusion and exclusion criteria.

### Quality Assessment

To ensure the reliability and validity of the selected

studies, a quality assessment was performed using the established criteria for evaluating the methodological rigor of each source. The assessment considers factors such as research design, data collection methods, and sample sizes. Documents then went through assessed for eligibility, so only 9 documents were included in this review

## Data Synthesis and ANALYSIS

### Thematic Analysis

Extracted data was thematically categorized to identify recurring themes related to vitamin D3 intake during pregnancy. Themes were derived from the research questions, patterns, similarities and differences across studies were identified.

## REPORTING

The findings of this systematic literature review were reported following established reporting guidelines for SLR (Moher et al., 2009). A comprehensive report included a narrative synthesis of key themes and findings along with implications for instructional design practice and recommendations for future research.

## Discussion

The present findings indicate that a positive correlation exists between the level of vitamin D3 and PT. Numerous studies have shown that most PT patients have a deficiency in vitamin D3, which affects

their lives (Agüero-Domenech et al., 2023; Flood-Nichols et al., 2015). In a study conducted in northern Brazil, Pereira-Santos, et al., (2018) stated, according to a study conducted in Belgium, that up to 12% of PT are severely vitamin D3 deficient, that over 60% of pregnant women reported taking multivitamins containing vitamin D3, and that vitamin D3 insufficiency is a severe vitamin D3 deficiency. A study by Vandevijvere et al., (2012) was also confirmed by Al-Faris (2016). In accordance with the present results, previous studies have demonstrated that the several observational studies point to low vitamin D3 status during pregnancy affecting maternal and neonatal ill health, including anxiety, depression, and postpartum, confirmed by studies by Lundqvist et al., (2016), and Ribamar et al., (2020). We conclude that vitamin D3 affects each mood disorder irritability, anxiety, and depression. Vitamin D3 deficiency occurs in pregnant women more frequently than in non-pregnant women.

## Recommendations

Every pregnant woman should be followed up on her vitamin D3 state in the blood over a long period of gestation because of its effect on her psychology. She also should be seen to consider intake the complement supplementation of Vitamin D3 as well as exposure to sunlight every day.

## Competing Interest

The authors had no competing interests.

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