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Research Article

Is there a Relationship between Postpartum Depression and Inadequate Vitamin D in the Last Trimester?

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Abstract

Objectives: Vitamin D insufficiency is common among pregnant women especially in their last trimester and it can be related to Postpartum Depression (PPD).

Materials and Methods: This study was conducted in Turgut Ozal University Maternity Clinic. Vitamin D levels measured at 36th gestational week of pregnancy and at 6th. week of postpartum Edinburg Postnatal Depressive Scale (EPDS) was filled in.

Results: The mean ± SD level of serum 25 (OH) D vitamin was 22.9 ± 16.2 ng/mL. Between participants with vitamin D insufficient and sufficient groups, age of mother, feeding type, EPDS scores were not statistically significant. The mean ± SD score of EPDS was 9.5 ± 5.3. A good relationship with the partner, low crying hour per day, breast feeding and formula feeding together and high weight gaining of baby per month were associated with low EPDS scores.

Conclusion: Although there is a high frequency of vitamin D insufficiency among pregnant women, no association between vitamin D level in the last trimester and PPD. A significant difference between feeding type of the infant, relationship with the partner, crying hour of the infant and infant's weight gain through a month and PPD.

Keywords: Postpartum depression; Vitamin D; Postnatal depression; Pregnancy

Introduction

Portpartum Depression (PPD) is defined as a non-psychotic depressive episode that starts in the postpartum period. It is a public health problem estimated to affect 10-15% of women world wide and can develop at any time during the first postpartum year [1,2]. In Turkey, 15% - 40% of mothers suffer from PPD symptoms [3,4]. However, almost half of the suffering mothers ignore and deny the symptoms of depression and choose not to seek professional help [5]. PPD affects not only the life of the women themselves, but it can also affect their families and their infants' growth and development [6].

Postpartum depression occurs mostly in young, lower-socioeconomic status women. Most commonly reported risk factors are past history of depression or other psychiatric illness, recent life stress, child care stress, difficult infant temperament and fatigue [2,7].

Vitamin D can be synthesised in the skin through exposure to Ultraviolet B (UV B) light and a small amount is obtained through dietary intake. Sunlight exposure is often the major influence on vitamin D status, but vitamin consumption can also strongly affect it [8]. Vitamin D level is also influenced by skin colour, latitude, season, lifestyle and cultural practices.

Once ingested or produced by the body, vitamin D3 is transported to the liver for hydroxylation to 25-Hydroxyvitamin D3 (25(OH) D), the main circulating form of vitamin D and the best measure of vitamin D status, and then to the kidney where the active hormonal form of vitamin D; 1,25(OH)2D, is produced. Maternal 25(OH)D is thought to freely cross the human placenta [9].

Recently, the Institute of Medicine defined adequate vitamin D status as having serum 25 (OH) D vitamin concentrations greater than 50 nmol/L (or 20 ng/mL) in both the general population and pregnant women [10]. Many investigators consider that optimal levels should be greater than 75 nmol/L or 30 ng/mL [11]. Current guidelines define vitamin D deficiency as serum levels of 25(OH)D below 20 ng/mL, insufficiency as serum levels between 20 and 32 ng/mL, and sufficiency as serum levels greater than 32 ng/mL, although there is debate whether this level may need to be increased to 40 ng/mL [12]. In pregnancy, vitamin D deficiency and insufficiency are also common. It has been suggested that a supplemental dose of vitamin D of 1000 or 1600 IU/day (25 to 40 mikrogram/day) might be necessary to achieve the optimal level [12].

In May 2011, the Turkish Ministry of Health suggested vitamin D 1200 IU/day (30 microgram/day) for 6 months prepartum and 6 months postpartum, totalling 12 months, to safely improve pregnancy and infant outcomes [13]. The biological mechanism linking vitamin D and mood disorders is still unclear. In the emerging literature examining the role of 25(OH) D in depression, vitamin D has been termed a 'neurosteroid' for its effect on brain function [14]. Active vitamin D enhances glutathione metabolism in neurons, thereby promoting antioxidant activities that protect those cells from oxidative degenerative processes [15]. Vitamin D deficiency has also been linked to altered brain morphology and may regulate gene expression of tyrosine hydroxylase, an enzyme involved in the

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Table 1: Characteristics of the mothers and children in the study.

Characteristics of Mother	mean±SD (range)
Age at child's birth	30,4±4.6(18-40)
Parity	1,8±0.8(1-4)
BMI prepregnancy	24.2±3.2(17.5-32.1)
Weight gain during pregnancy	13.5±4.0(5-24)
EPDS score	9.5±5.3(0-25)
Serum 25 (OH) D vitamin(ng/Ml)	22.9±16.2(4.9-99)
Occupational status, *n* (%)	
House wife	54(58.7)
Office holder	26(28.3)
Private sector employee	12(13)
Monthly income, *n* (%)	
Low	13 (14.1)
Medium	59 (64.1)
High	26 (21.7)
Relationship with the partner, *n* (%)	
Bad	0(0)
Medium	30(32.6)
Good	62(67.4)
Having helper, *n* (%)	66(71.7)
Characteristics of Child	
APGAR score	8.9±0.5(6-10)
Weight gain in a month (gr)	952±290(500-2000)
Complication at childbirth, *n* (%)	3(3.3)
Crying hour in a day	
≤1 hour	40(43.5)
1-3 hour	45(48.9)
≥ 3 hours	7(7.6)
Feeding type, *n* (%)	
Breastfeeding	60(65.2)
Formula feeding	12(13)
Breastfeeding + Formula feeding	20 (21.7)

synthesis of neurotransmitters such as norepinephrine and dopamine [15]. It also could be related to the location of Vitamin D Receptors (VDRs) within the brain. VDRs are inadequately occupied in the presence of vitamin D deficiency (25(OH) D <20 ng/mL), which may interfere with proper functioning of hormonal processes that prevent disease within the brain, such as mood disorders [12].

Prediction of postpartum depression and treatment of vitamin D deficiency/insufficiency can prevent PPD and this is very important for the benefit of the mother and also her children. This exploratory study was conducted to determine whether a longitudinal relationship exists between symptoms associated with postpartum depression and inadequate vitamin D in the last trimester.

In the literature, vitamin D has been measured in the first or second trimester. However, in the last trimester vitamin D levels may change by factors such as consumption of foods rich in vitamin D or by sunshine. This is the first study measuring vitamin D levels in the last trimester (36th gestational week) and its association with PPD.

Material and Methods

Study design

This small cohort study was conducted in the Turgut Ozal University Maternity Clinic between 1st January 2013 and 1st July 2013, with 92 women satisfying the inclusion criteria.

The sample size was estimated to detect a minimum clinically significant difference of the association between vitamin D level and postpartum depression to have 80% power with 5% type I error level. The estimated sample size was 79 patients.

The study was approved by the Fatih University Medical School Ethics Committee, and written informed consent was obtained from all participating mothers.

Study population

Participants met all of the following inclusion criteria: aged 18 to 45 years, delivered an infant who was at least 37 weeks gestation, having singleton pregnancy, not having systemic or psychological disease, and having taken a vitamin supplement (500 IU/day vitamin D) throughout the pregnancy.

Blood sample

Pregnant women who were in the 36th gestational week, had their blood sampled for 25 (OH) vitamin D. These venous blood samples were centrifuged at 4000 rpm/minute for 10 minutes and serum was collected and stored at -80 °C. Serum 25 (OH) vitamin D concentrations were analyzed by high-performance liquid chromatography (Shimadzu - DGU-20A3, Kyoto, Japan).

Serum 25(OH)D3 levels <20 ng/mL (50 nmol/L) were classified as vitamin D deficient, and < 32 ng/mL (75 nmol/L) as vitamin D insufficiency.

Measure of depressive symptoms

The Edinburg Postnatal Depressive Scale (EPDS) was used to measure depressive symptoms 6 weeks after delivery. The EPDS is a 10-item, self-rating questionnaire developed to screen for depression in the postpartum period; it addresses symptoms present during the previous seven days. The scale consists of 10 short statements with responses scored as 0, 1, 2, or 3 and takes approximately 5 minutes to complete. A cut off of 10 or above was found to have good psychometric properties for a diagnosis of depression [1,16]. The linguistic and pilot studies in order to be able to apply EPDS to Turkish women were conducted [17].

Other study factors

Maternal data: The demographic information collected included maternal age and occupation, gravida and parity, relationship with the partner, number of previous children, prepregnancy BMI, weight gain in the pregnancy, and having a helper at home.

Infancy data: The information collected included mode of delivery, gestational age, any complications in childbirth, APGAR score, 1 month old weight gain and feeding status, and crying hours in a day.

Table 2: Comparison of mothers in vitamin D insufficient and vitamin D sufficient groups.

	Vitamin D Insufficient Group (n=68)	Vitamin D Sufficient Group (n=29)	p value
Age (y)[a]	29.7±4.4	31.2±5.4	0.2
Weight gain during pregnancy (kg)[a]	13.7±4.2	13.3±2.7	0.66
EPDS score[a]	9.5±5.6	9.4±4.7	0.93
Feeding type n,%			0.33
Breastfeeding	41(73.2)	15(26.8)	
Formula feeding	10(90.9)	1(9.1)	
Breastfeeding + Formula feeding	17(85)	3(15)	

[a]Mean ± SD

Statistical analyses

SPSS version 16.0 (SPSS, Chicago, IL, USA) for Windows program was used for statistical analyses. Kolmogorov-smirnow test was used to determine normal distribution. Descriptive statistics were presented as mean and Standard Deviations (SD) for not normally distributed data, and as counts and percentages for categorical data. Normally distributed and with homogeneous variances groups were compared two groups by Student's t test. Mann-Whitney test was used for data not normally distributed. Chi-squared test was used to evaluate relationship between categorical variables. A Spearman correlation coefficient and its' significance was calculated for the association between PPD and vitamin D level. A logistic regression analysis was performed to determine the independent effects of vitamin D on PPD. The Hosmer-Lemeshow goodness of fit test was also performed. The statistical significance level was set at $P < 0.05$.

Results

A total of 92 women with the age of 30.4 ± 4.6 years between the range of 18 and 40 were recruited in this study. More than half of them are house wife and nearly three-quarters of women have helper, and 67.4% of them have good relationship with their partner.

Blood samples of five participants missed, so we studied 87 blood samples for vitamin D level.

The mean ± SD of EPDS score assessed 6 weeks after delivery in 92 women was 9.5 ± 5.3 with the range of 0 and 25. The mean ± SD of vitamin D level measured at 36th gestational week in 87 women was 22.9 ± 16.2 ng/mL with the range of 4.9 and 99.

The characteristics of the mothers studied and their children are shown in (Table 1).

In (Table 2), participants with vitamin D insufficiency (25 (OH) D≤32 ng/mL) and sufficiency (25 (OH) D>32 ng/mL) are compared.

Vitamin D Deficiency (VDD) was defined as 25(OH) vitamin D levels less than 37.5 nmol/L or 20 ng/mL. In our study, we classed groups by the level of 25(OH) vitamin D as less than 20 ng/mL or above this level. Among all patients, the VDD group was 55.4% (n=51) while the non-VDD group was 44.6% (n=41).

We did not find any correlation between EPDS score and vitamin D level (P =0.87) with analysing Spearman correlation test.

Of participants 46.7% (n=43) had EPDS scores above 10. In (Table 3), EPDS scores ≥10 and EPDS scores <10 are compared. A good relationship with the partner, low crying hour per day, breastfeeding and formula feeding together and high weight gaining of baby per month were associated with low EPDS scores. Age of mother at the child's birth, occupational status, weight gain during pregnancy, being primiparus, vitamin D level and having a helper at home were not associated with PPD.

In the logistic regression analyses, when the independent variables (crying hour, relationship with the partner, weight gain of the infant, feeding type) were controlled, vitamin D insufficiency in depressive women was 1.9 times higher than the women not having postpartum depression, but it is not statastically significant (P=0.26).

Discussion

Postpartum depression effects the whole family and also infant's growth and development negatively [6]. Knowing the risk factors of PPD and also treating is crucial. In some studies the researchers found that low level of vitamin D measured in the first and second trimester of pregnancy were linked to greater reporting of postnatal depressive symptoms [18,19].

In the present study, we expected to find that low vitamin D levels would be an important predictor of PPD, but similar to Nina ON's study from Denmark, there was no statistically important difference [20]. The present study is the first study measuring vitamin D level in the 36th gestational week in pregnant women taking 500 IU Daily vitamin D supplement. Nina ON et al. measured D vitamin levels at less than 23 weeks of pregnancy, and 85% of participants had a multivitamin supplementation during pregnancy [20]. Low levels of vitamin D show that 500 IU vitamin supplementation is not sufficient, however the suggested supplemental dose of vitamin D is 1000 or 1600 IU/day (25 to 40 microgram/day) [11].

Our study is not in concordance with a new published study from Turkey [21]. In that study, Gur EB et al. have measured vitamin D levels at midpregnancy (between 24-28 gestational weeks) and PPD at 1 week, 6 weeks and 6 months. Like our study, in their study most of the participants (84.6%) used a vitamin D supplement of 400 IU, not a sufficient dose, and the median level of vitamin D was consistent with this. They showed a statistically significant association between PPD and inadequate vitamin D levels at 1 week, 6 week and 6 months [21]. Because of the low dose of supplementation inadequate Vitamin D is still common. As shown by Halicioglu et al. examining winter and spring levels of 25(OH) D3 inadequate vitamin D is still common among pregnant and unsupplemented vitamin D women living in Turkey [22]. Although the recommendation of the Ministry of Health of Turkey and other international organizations is vitamin D

Table 3: Comparison of EPDS score ≥10 and EPDS score <10 group.

	EPDS score ≥ 10 (n=43)	EPDS score<10 (n=49)	*p* value
Age at child's birth (y)	[a]29.1±4.8	30.8±4.2	0.08
Weight gain during pregnancy (kg)	[a]14.0±4.4	13.1±3.6	0.29
D vitamin level (ng/mL)	[a]21.8±15.1	23.9±17.3	0.29
APGAR score	[a]8.9±0.73	8.9±0.42	0.94
Weight gain in a month (gr)	8.9±0.42	1032±282	0.004
Having helper n, %	861±272	26(53)	
Primiparous n, %	20(47)	27(55.6)	0.85
Crying hour during a day n, %	19(44.4)		0.85
≤1 hour 12(30)	28(70)		0.001
1-3 hour 24 (53)	21(47)		
≥3 hours 7(100)	0(0)		0.07
Occupational status n, %	21(38.9)	33(61.1)	
House wife	13(50)	13(50)	
Office holder	9(75)	3(25)	0.77
Private sector employee	6(14)	7(14.3)	
Monthly income n, %	29(67.4)	30(61.2)	
Low	8(18.6)	12(24.5)	
Medium			0.02
High	0(0)	0(0)	
Bad	21(70)	9(30)	
Medium	22(35.5)	40(64.5)	
Good			0.001
Breastfeeding	21(35)	39(65)	
Formula feeding	5(41.7)	7(58.3)	
Breastfeeding + Formula feeding	17(85)	3(15)	

[a]Mean ± SD

supplementation for pregnant women of 1000-1200 or 1600 IU/day, it is not a common practice among gynecologists in our country. We think the main causes of this problem are not having regular follow-up of pregnant women and believing that in a sunny country, sunshine is an adequate source of vitamin D. The PPD level at six weeks in our study was two fold of Gur EB's study (46.7% versus 23.2%). This difference may be due to cutoff EPDS score (10 versus 12).

The present study also does not support Monique R et al.'s study from Australia and Murphy PK et al.'s study from America [18,19]. Monique R et al. measured vitamin D level at the 18th gestational week, all of participants did not have vitamin D supplementation and they measured postnatal blues, not PPD. Postpartum blues may predict PPD [23], but there may also be recovery from postpartum blues [9]. Murphy PK et al. examined 25(OH) vitamin D levels postnatally and the risk for PPD, and found that low levels of vitamin D were linked to greater reporting of postnatal depressive symptoms up to 7 months postpartum. However, there was no prospective measure of 25(OH) vitamin D during pregnancy [19].

The results from this study suggest that mothers who have only breastfed or bottle-fed are prone to PPD, however Pocan's study showed mothers who had bottle-fed were more likely to be depressed than those who breastfed [24]. In Turkey, breastfeeding is an important component of motherhood. We think mothers who have bottle-fed are not satisfied in motherhood in Turkey, but mothers having only breastfed concern about their breast milk whether enough or not. But in a study from Canada, Dennis found no relationship between diverse infant feeding methods [25]. There are mixed results in various studies.

Weight gain of the baby is a very important motivator for parents, especially mothers. Weight gain shows good parenting and good care in our culture. In the present study, newborns had visits to the pediatrician at the 5th, 15th and 30th day after delivery. When the baby is only breastfed and weight gain is less than expected, bottle feeding is recommended by the pediatricians. Previous research found an association between breastfeeding difficulties and maternal mood [25]. Not nursing a baby is a risk factor for depression, being perceived as poor parenting.

Having a poor relationship with the father of the infant is in accordance with the studies suggesting that inadequate support or problematic relationships were found to be strong predictors of PPD [26].

In the present study, the crying hours of an infant in one day was strongly associated with risk of PPD, which is in accordance with the

literature. The longer the crying hours, the greater the vulnerability to PPD. When the crying hours of an infant were greater than three hours per day, in other words a colicky infant, this was stressful for caregivers and also was associated with an elevated risk of PPD [27].

In addition to vitamin D levels, there was no significant association between PPD and age of the mother, occupational status, monthly income, weight gain during pregnancy, being primiparus and not having a helper at home. Our study was conducted in a private hospital in the capital city of Turkey. Most of women had medium or high socioconomic status, because the study was conducted in a private hospital, but in contrast to the literature PPD ratio was high [1,2]. Income and employment status were not asoociated with PPD in our study, similar to Pocan' s study, but in contrast to Dindar's study and Ekuklu's study [3,24,26].

In contrast to Pocan's study, family support for baby care is not associated with PPD [24]. In Turkey, support of the mother by close relatives, especially by the grandmothers, within the first 40 days is a common practice. However, in a study from Australia, Bilzsta JL and his colleagues showed that close familial contact can be a source of stress for new mothers by affecting communication negatively [28].

We have studied participants during six months of the year, considering winter and spring (January through July). Our country and also our city is in a sunny region and can benefit from sunshine. But vitamin D arising from sunshine is less in the winter months. As in pregnant women, in other individuals vitamin D deficiency/ insufficiency is common in Turkey [22,29]. So vitamin D supplementation is recommended for pregnant and nursing women and for infants by the Ministry of Health of Turkey [13]. We did not investigate the relationship between season and PPD. In the literature, depressive symptoms and also PPD are common in the dark months [30]. One of the causes of high PPD scores in the present study may be that it was conducted in winter and spring. But for an accurate result, the study should be conducted for the whole year.

The present study has several limitations. The study was conducted in a private hospital in the capital city of Turkey. Most of the participants were in medium or high socioeconomic level. Further studies with larger samples at all socioeconomic levels and conducted in whole seasons of the year should be performed. Another limitation is about the participants having PPD. These participants were not evaluated by the psychiatrist.

Conclusion

Our findings revealed a high frequency of vitamin D insufficiency among pregnant women, suggesting that appropriate vitamin D supplementation should be given. However, there was no association between vitamin D levels in the last trimester and PPD; an association established between feeding method of the infant, relationship with the partner, crying hours of the infant and PPD. Physicians should be aware of PPD and closely follow women in both pregnancy and postpregnancy for signs of PPD.

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