Status of Maternal Serum Vitamin D Levels in Rural India

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Abstract: *Background:* The role of Vitamin D during pregnancy and its effect on maternal and fetal health is just beginning to be understood. What is clear, however, is that Vitamin D deficiency during pregnancy is rampant throughout the world. Vitamin D deficiency is prevalent in India, a finding that is unexpected in a tropical country with abundant sunshine. Various studies have shown an intrinsic relation between various parameters of maternal and fetal wellbeing with maternal Vitamin D status during pregnancy.

Aim: To determine the status of Vitamin D levels in pregnancy among rural mothers.

Methods: A total of 60 pregnant females, aged 20-35 years were studied during the third trimester of pregnancy. Serum Vitamin D was measured by chemiluminescent immunoassay.

Results: 65% subjects were found to have Vitamin D deficiency and 26.67% were found to have Vitamin D insufficiency whereas 8.33% had normal Vitamin D levels. Mean maternal serum Vitamin D level was 15.97±9.216 ng/mL.

Conclusions: We observed a high prevalence of physiologically significant hypovitaminosis D among pregnant women attending rural hospital. As mentioned in literature, Vitamin D deficiency is associated with adverse fetomaternal outcome, the magnitude of hypovitaminosis D in antenatal period warrants public health intervention.

Keywords: Vitamin D, Vitamin D deficiency, Pregnancy, Hypovitaminosis D, India.

INTRODUCTION

Vitamin D deficiency is pandemic, yet it is the most under-diagnosed and under-treated nutritional deficiency in the world [1-3]. In tropical country like India where there is abundant sunlight for whole of the year, hypovitaminosis is unexpected. Reason for this could be the Indian socioreligious and cultural practices which do not facilitate adequate sun exposure, thereby negating potential benefits of plentiful sunshine. Furthermore in India, which is a developing country, milk, the primary source of calcium, is an expensive food which could not be afforded by rural population on daily basis. In addition to this, dairy products which are consumed more in urban areas are rarely fortified with Vitamin D. Consequently, subclinical Vitamin D deficiency is highly prevalent in both urban and rural settings, and across all socioeconomic and geographic strata [4]. Vitamin D deficiency is highly prevalent in urban and rural India [5, 6] , and pregnant women and newborns are vulnerable groups [7, 8]. Data regarding appropriate doses of Vitamin D during pregnancy are scant [9-12]. Several clinical studies suggest the possible association between low Vitamin D levels and potential adverse outcomes of pregnancy [13-16].

Owing to its multifarious implications on health, the epidemic of Vitamin D deficiency in India is likely to significantly contribute to the enormous burden on the healthcare system of India. The socioeconomically backward people constitute a large percentage of the population in India. The underprivileged generally suffer from overall poor nutrition. Vitamin D rich dietary sources are limited and unaffordable to most Indians. Cultural and social taboos often dictate lifestyle patterns such as clothing-that may limit sun exposure and vegetarianism-which certainly limits Vitamin D rich dietary options. Vitamin D supplements are available at very cheap cost, but most Indians are not aware that they need additional Vitamin D. We undertook this study to determine the prevalence of Vitamin D deficiency in pregnant women in a rural community.

METHODOLOGY

This study was conducted in Department of Obstetrics and Gynaecology, Acharya Vinoba Bhave Rural Hospital (AVBRH) at Sawangi (Meghe), Wardha, Maharashtra. It was a cross sectional study comprisisng of 60 pregnant.

Inclusion criteria:

- Gravid women
- Live singleton pregnancy

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Exclusion criteria:

- Clinical evidence of medical and metabolic disorder in pregnancy including hypertension, pregestational diabetes, renal disease, lupus, or multiple gestations.
- Patients who are not willing to participate in study.

Demographic details were taken. Socioeconomic status was calculated using Modified Kuppuswamy Classification [17]. Blood sample for serum Vitamin D level was collected. Maternal Vitamin D levels were measured by immune assay test in Advia centaur which works on CLIA (chemiluminescent immunoassay).

Serum Vitamin D (25-OH-D) Cutoff Points

According to the 2011 ACOG Practice Bulletin "Vitamin D: Screening and Supplementation"[18] and according to Endocrine Society guidelines [19]

- Deficiency is defined as levels <20 ng/mL
- Insufficiency as levels 21 ng/mL - 29 ng/mL
- Normal > 30 ng/mL and ≤100 ng/mL

RESULTS

Sixty pregnant females were studied during the third trimester of pregnancy.

- The mean age was found to be 24.56 years. Maximum were in the age group of 21-25 constituting 51.67%. (Table **1** and Figure **1**)
- 55% were primigravida whereas 45% were multigravida. (Table **2** and Figure **2**)
- 73.3% of subjects belong to upper lower socio economic status that is class IV. (Table **3** and Figure **3**)
- The mean period of gestation was found to be 38.56±1.69 weeks. (Table **4** and Figure **4**)
- 65% subjects were found to have Vitamin D deficiency and 26.67% were found to have Vitamin D insufficiency whereas only 8.33% had normal Vitamin D levels. Mean maternal serum Vitamin D level was 15.97±9.216 ng/mL. (Table **5** and Figure **5**)

Table 1: Age Wise Distribution of Subjects

Age Group (years)	No. of Subjects n=60
≤20	11(18.33%)
21-25	31(51.67%)
26-30	15(25%)
31-35	3(5%)
Total	60(100%)
Mean ± SD	24.56±3.64

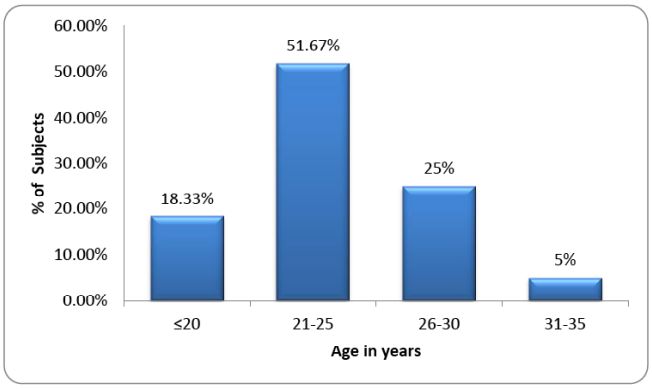

Figure 1: Age wise distribution of subjects.

Table 2: Distribution of Subjects According to Gravidity

Gravidity	No. of Subjects n=60
G1	33(55%)
G2	17(28.3%)
G3	8(13.3%)
>G3	2(3.3%)
Total	60(100%)

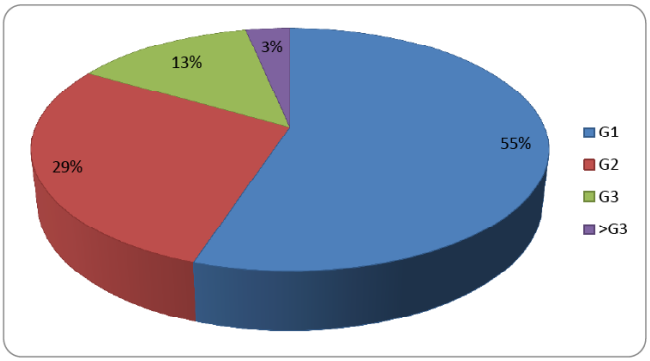

Figure 2: Distribution of subjects according to Gravidity.

Table 3: Distribution of Subjects According to Socio-Economic Status

Socio-Economic Status (Kuppuswamy)	No. of Subjects n=60
I(Upper)	0(0%)
II(Upper Middle)	0(0%)
III(Middle/lower middle)	10(16.7%)
IV(Upper Lower)	44(73.3%)
V(Lower)	6(10%)
Total	60(100%)

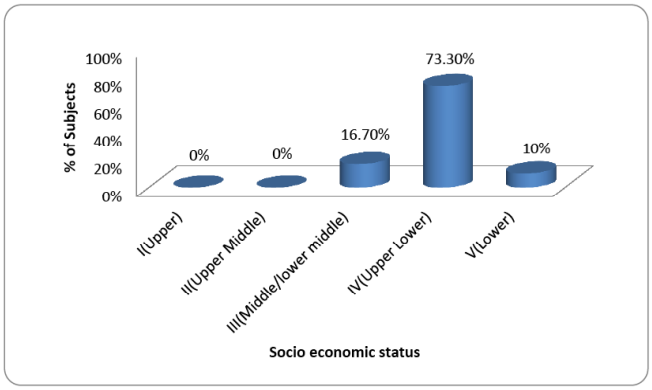

Figure 3: Distribution of subjects according to socio-economic status

Table 4: Distribution of Subjects According to Period of Gestation (in weeks)

Period of Gestation (in Weeks)	No. of Subjects n=60
32-36.6	9(15%)
37-40	39(65%)
>40	11(18.33%)
Unknown	1(1.67%)
Total	60(100%)
Mean ± SD	38.56±1.69

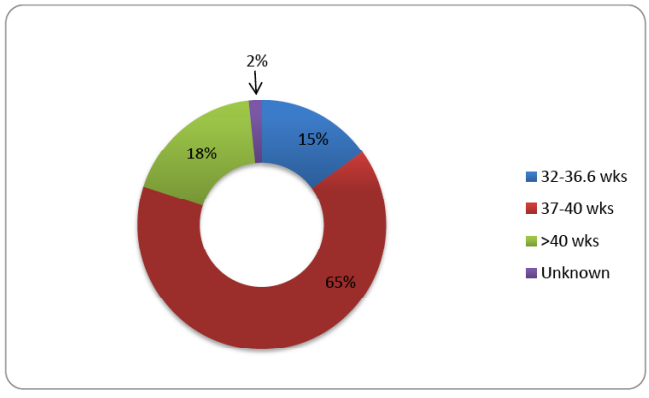

Figure 4: Distribution of Subjects according to period of gestation (in weeks)

Table 5: Status of Serum Vitamin D Level in Subjects

Vitamin D (ng/mL)	No. of Subjects n=60
>30 Normal	5(8.33%)
20-30 Insufficient	16(26.67%)
<20 Deficient	39(65.00%)
Total	60(100%)
Mean ± SD	15.97±9.216

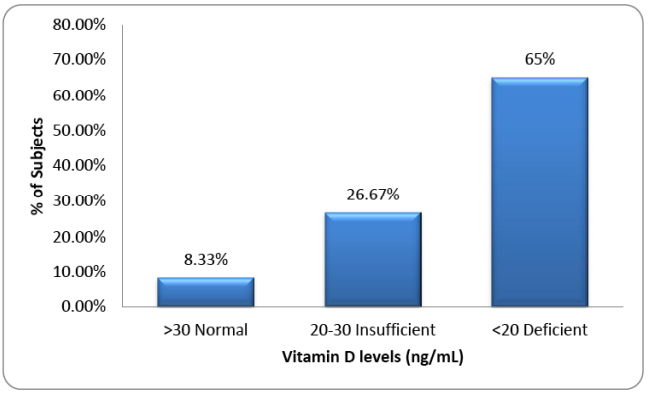

Figure 5: Status of serum Vitamin D level in subjects.

DISCUSSION

The most important finding in present study was the unexpectedly high prevalence of hypovitaminosis D in the pregnant population, 65% of subjects were Vitamin D deficient. Previous studies among pregnant women from south and north India have reported high Vitamin D deficiency levels with values varying from 67% to 96% [6, 20-22].

The first Indian study on Vitamin D status in singleton pregnancy by Goswami *et al.* [20] in year 2000 reported 60-70% prevalence of Vitamin D deficiency. Subsequently Sachan *et al.* [22] in 2005 also reported 84% prevalence of Vitaminn D deficiency in women with singleton pregnancies. Other Indian studies have reported similar findings in singleton pregnancies.

In the study conducted by Sahu *et al.* [6] in 2008 74% of pregnant residents of Barabanki district had Vitamin D deficiency 25OHD < 30ng/ml.

Similar findings were observed in few of the Indian studies mentioned below.

Prevalence of Hypovitaminosis D

Prevalence of Vitamin D Deficiency	Studies Results
Goswami *et al* (2000) [20]	60-70%
Sachan *et al* (2005) [22]	84%
Sahu *et al* (2008)[6]	74%
Farrant H.J. *et al* (2009)[23]	66.5%
Krishnaveni G.V. *et al* (2011) [24]	67%
Marwaha R.K. *et al* (2011) [21]	96.3%
Jani R. *et al* (2014) [25]	93.75%
Present Study	65%

Vitamin D deficiency has been linked to adverse perinatal outcomes in recent epidemiologic data [26]. During initial to mid-trimesters, the fetal organs begin to develop and there is start of skeleton formation in form of collagen matrix. The skeleton of the fetus begins to calcify in the last trimester, thereby increasing maternal demand for calcium. This demand is met by increased production of 1,25dehydrocholecalciferol by the mother's kidneys & placenta. Circulating concentrations of 1,25dehydrocholecalciferol gradually increase during the 1st & 2nd trimesters, owing to an increase in Vitamin D-binding protein concentrations in the maternal circulation. However, the free levels of 1,25dehydrocholecalciferol, which are responsible for enhancing intestinal calcium absorption, are only increased during the 3rd trimester [19]. Vitamin D deficiency during pregnancy is linked with preeclampsia [27], gestational diabetes mellitus, preterm labour [28, 29] and an increased risk for caesarean section delivery[30]. It was speculated that these conditions may result from the lack of action of Vitamin D in immunosuppression or placental development among deficient patients [26, 27, 31, 32]. Maternal Vitamin D deficiency is associated with subtle fetal bone abnormalities like shorter knee-heel length [33], low birth weight [34] & high risk of being small for gestational age (SGA) [35].

At present, Vitamin D supplementation is not a part of national antenatal care programs in India. The US National Academy of Sciences mentions 400 IU as the dietary reference intake for Vitamin D during pregnancy. On an individual basis, a mother should be supplemented with adequate amounts of Vitamin D to ensure that her 25-hydroxyvitamin D levels are in a sufficient range (>32ng/mL)[36-39]. However, several investigators worldwide are arguing for revised higher guidelines for Vitamin D allowance during pregnancy and lactation [40].

CONCLUSION

Vitamin D deficiency and insufficiency is problem that has been highlighted in literature for a number of years but response is slow. Vitamin D deficiency in the rural area in pregnant women appears to be high. Vitamin D screening in antenatal period should be started as routine investigation in the early trimesters itself. Vitamin D supplementation can be a safe and cheap method of improving the nutritional status of pregnant women and achieving good maternal and fetal outcome. Thus, early detection of Vitamin D deficiency, and supplementation with Vitamin D to achieve reasonable serum levels during pregnancy, should be explored as a safe and effective primordial means of promoting good pregnancy outcome. However, larger studies are needed before reaching any conclusion regarding its association with pregnancy outcome.

REFERENCES

[1] Mithal A, Wahl D, Bonjour J-P, Burckhardt P, Dawson-Hughes B, Eisman J, *et al*. Global vitamin D status and determinants of hypovitaminosis D. Osteoporosis international. 2009; 20(11): 1807-20. http://dx.doi.org/10.1007/s00198-009-0954-6

[2] van der Meer IM, Middelkoop BJC, Boeke AJP, Lips P. Prevalence of vitamin D deficiency among Turkish, Moroccan, Indian and sub-Sahara African populations in Europe and their countries of origin: an overview. Osteoporos Int. 2011; 22(4): 1009-21. http://dx.doi.org/10.1007/s00198-010-1279-1

[3] Van Schoor NM, Lips P. Worldwide vitamin D status. Best practice & research Clinical endocrinology & metabolism. 2011; 25(4): 671-80. http://dx.doi.org/10.1016/j.beem.2011.06.007

[4] Gupta GR, Vitamin A, Deficiency D. in India: Prevalence, Causalities and Interventions. Nutrients. 2014; 6(2): 729-75. http://dx.doi.org/10.3390/nu6020729

[5] Balasubramanian K, Rajeswari J, Govil Y, Agarwal A, Kumar A, Bhatia V. Varying role of vitamin D deficiency in the etiology of rickets in young children vs. adolescents in northern India. Journal of tropical pediatrics. 2003; 49(4): 201-6. http://dx.doi.org/10.1093/tropej/49.4.201

[6] Sahu M, Bhatia V, Aggarwal A, Rawat V, Saxena P, Pandey A, *et al*. Vitamin D deficiency in rural girls and pregnant women despite abundant sunshine in northern India. Clinical endocrinology. 2009; 70(5): 680-4. http://dx.doi.org/10.1111/j.1365-2265.2008.03360.x

[7] Balasubramanian S, Shivbalan S, Kumar PS. Hypocalcemia due to vitamin D deficiency in exclusively breastfed infants. Indian pediatrics. 2006; 43(3): 247.

[8] Sachan A, Gupta R, Das V, Agarwal A, Awasthi PK, Bhatia V. High prevalence of vitamin D deficiency among pregnant

women and their newborns in northern India. The American journal of clinical nutrition. 2005; 81(5): 1060-4.

[9] Brooke O, Brown I, Bone C, Carter N, Cleeve H, Maxwell J, *et al*. Vitamin D supplements in pregnant Asian women: effects on calcium status and fetal growth. BmJ. 1980; 280(6216): 751-4. http://dx.doi.org/10.1136/bmj.280.6216.751

[10] Datta S, Alfaham M, Davies D, Dunstan F, Woodhead S, Evans J, *et al*. Vitamin D deficiency in pregnant women from a non-European ethnic minority population—an interventional study. BJOG: An International Journal of Obstetrics & Gynaecology. 2002; 109(8): 905-8.

[11] Madelenat P, Bastian H, Menn S. [Winter supplementation in the 3rd trimester of pregnancy by a dose of 80,000 IU of vitamin D]. Journal de gynecologie, obstetrique et biologie de la reproduction. 2001; 30(8): 761-7.

[12] Marya R, Rathee S, Dua V, Sangwan K. Effect of vitamin D supplementation during pregnancy on foetal growth. Indian journal of medical research. 1988; 88:488-92.

[13] Lucas RM, Ponsonby A-L, Pasco JA, Morley R. Future health implications of prenatal and early-life vitamin D status. Nutrition reviews. 2008; 66(12): 710-20. http://dx.doi.org/10.1111/j.1753-4887.2008.00126.x

[14] Mulligan ML, Felton SK, Riek AE, Bernal-Mizrachi C. Implications of vitamin D deficiency in pregnancy and lactation. American journal of obstetrics and gynecology. 2010; 202(5): 429. e1-e9.

[15] Thorne-Lyman A, Fawzi WW. Vitamin D during pregnancy and maternal, neonatal and infant health outcomes: a systematic review and meta-analysis. Paediatr Perinat Epidemiol. 2012; 26(0 1).

[16] Wagner CL, Taylor SN, Dawodu A, Johnson DD, Hollis BW. Vitamin D and its role during pregnancy in attaining optimal health of mother and fetus. Nutrients. 2012; 4(3):208-30. http://dx.doi.org/10.3390/nu4030208

[17] Kumar N, Gupta N, Kishore J. Kuppuswamy's socioeconomic scale: updating income ranges for the year 2012. Indian J Public Health. 2012; 56(1): 103-4. http://dx.doi.org/10.4103/0019-557X.96988

[18] ACOG Committee Opinion No. 495: Vitamin D: Screening and supplementation during pregnancy. Obstet Gynecol. 2011; 118(1): 197-8. http://dx.doi.org/10.1097/AOG.0b013e318227f06b

[19] Holick MF, Binkley NC, Bischoff-Ferrari HA, Gordon CM, Hanley DA, Heaney RP, *et al*. Evaluation, treatment, and prevention of vitamin D deficiency: an Endocrine Society clinical practice guideline. J Clin Endocrinol Metab. 2011; 96(7): 1911-30. http://dx.doi.org/10.1210/jc.2011-0385

[20] Goswami R, Gupta N, Goswami D, Marwaha RK, Tandon N, Kochupillai N. Prevalence and significance of low 25-hydroxyvitamin D concentrations in healthy subjects in Delhi. Am J Clin Nutr. 2000; 72(2): 472-5.

[21] Marwaha RK, Tandon N, Chopra S, Agarwal N, Garg MK, Sharma B, *et al*. Vitamin D status in pregnant Indian women across trimesters and different seasons and its correlation with neonatal serum 25-hydroxyvitamin D levels. Br J Nutr. 2011; 106(9):1383-9. http://dx.doi.org/10.1017/S000711451100170X

[22] Sachan A, Gupta R, Das V, Agarwal A, Awasthi PK, Bhatia V. High prevalence of vitamin D deficiency among pregnant women and their newborns in northern India. Am J Clin Nutr. 2005; 81(5):1060-4.

[23] Farrant HJ, Krishnaveni GV, Hill JC, Boucher BJ, Fisher DJ, Noonan K, *et al*. Vitamin D insufficiency is common in Indian mothers but is not associated with gestational diabetes or variation in newborn size. Eur J Clin Nutr. 2009; 63(5): 646-52. http://dx.doi.org/10.1038/ejcn.2008.14

[24] Krishnaveni GV, Veena SR, Winder NR, Hill JC, Noonan K, Boucher BJ, *et al*. Maternal vitamin D status during pregnancy and body composition and cardiovascular risk markers in Indian children: the Mysore Parthenon Study. Am J Clin Nutr. 2011; 93(3): 628-35. http://dx.doi.org/10.3945/ajcn.110.003921

[25] Jani R, Palekar S, Munipally T, Ghugre P, Udipi S. Widespread 25-hydroxyvitamin d deficiency in affluent and nonaffluent pregnant Indian women. BioMed research international. 2014; 2014.

[26] Robinson CJ, Alanis MC, Wagner CL, Hollis BW, Johnson DD. Plasma 25-hydroxyvitamin D levels in early-onset severe preeclampsia. Am J Obstet Gynecol. 2010; 203(4): 366.e1-6. http://dx.doi.org/10.1016/j.ajog.2010.06.036

[27] Bodnar LM, Catov JM, Simhan HN, Holick MF, Powers RW, Roberts JM. Maternal vitamin D deficiency increases the risk of preeclampsia. J Clin Endocrinol Metab. 2007; 92(9): 3517-22. http://dx.doi.org/10.1210/jc.2007-0718

[28] Arora CP, Hobel C. Vitamin D-a novel role in pregnancy. Biopolymers and Cell. 2010; 26(8).

[29] Arora CP, Huynh P, Bergman A, Sarafin D, Hobel CJ, editors. Vitamin D & IL-6 Levels in Pregnancies with Subsequent Spontaneous Preterm Birth. Reproductive Sciences; 2010: SAGE PUBLICATIONS INC 2455 TELLER RD, THOUSAND OAKS, CA 91320 USA.

[30] Merewood A, Mehta SD, Chen TC, Bauchner H, Holick MF. Association between Vitamin D Deficiency and Primary Cesarean Section. J Clin Endocrinol Metab. 2009; 94(3): 940-5. http://dx.doi.org/10.1210/jc.2008-1217

[31] Baker AM, Haeri S, Camargo CA, Jr., Espinola JA, Stuebe AM. A nested case-control study of midgestation vitamin D deficiency and risk of severe preeclampsia. J Clin Endocrinol Metab. 2010; 95(11): 5105-9. http://dx.doi.org/10.1210/jc.2010-0996

[32] Lopez-Jaramillo P, Casas JP, Serrano N. Preeclampsia: from epidemiological observations to molecular mechanisms. Braz J Med Biol Res. 2001; 34(10): 1227-35. http://dx.doi.org/10.1590/S0100-879X2001001000001

[33] Morley R, Carlin JB, Pasco JA, Wark JD. Maternal 25-hydroxyvitamin D and parathyroid hormone concentrations and offspring birth size. J Clin Endocrinol Metab. 2006; 91(3):906-12. http://dx.doi.org/10.1210/jc.2005-1479

[34] Scholl TO, Chen X. Vitamin D intake during pregnancy: association with maternal characteristics and infant birth weight. Early human development. 2009; 85(4):231-4. http://dx.doi.org/10.1016/j.earlhumdev.2008.10.006

[35] Leffelaar ER, Vrijkotte TG, van Eijsden M. Maternal early pregnancy vitamin D status in relation to fetal and neonatal growth: results of the multi-ethnic Amsterdam Born Children and their Development cohort. British Journal of Nutrition. 2010; 104(01): 108-17. http://dx.doi.org/10.1017/S000711451000022X

[36] Hathcock JN, Shao A, Vieth R, Heaney R. Risk assessment for vitamin D. The American journal of clinical nutrition. 2007; 85(1):6-18.

[37] Holick MF. Vitamin D deficiency. New England Journal of Medicine. 2007; 357(3): 266-81. http://dx.doi.org/10.1056/NEJMra070553

[38] Hollis BW, Wagner CL, Kratz A, Sluss P, Lewandrowski K. Normal serum vitamin D levels. N Engl J Med. 2005; 352(5): 515-6. http://dx.doi.org/10.1056/NEJM200502033520521

[39] Vieth R, Bischoff-Ferrari H, Boucher BJ, Dawson-Hughes B, Garland CF, Heaney RP, *et al*. The urgent need to

recommend an intake of vitamin D that is effective. The American journal of clinical nutrition. 2007; 85(3): 649-50.

[40] Hollis BW, Wagner CL. Assessment of dietary vitamin D requirements during pregnancy and lactation. The American Journal of Clinical Nutrition. 2004; 79(5): 717-26.

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