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IMPACT OF DIET ON VITAMIN D STATUS IN A SELECTED POPULATION OFPREGNANT MOTHER IN SRI LANKA

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ABSTRACT

Key Words :

Diet
Vitamin D
Pregnancy
Calcium
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Abstract *: Results of various studies have shown severe vitamin D deficiency in the Indian subcontinent in all age groups and insufficiency in populations of South-East and East Asia. There are no data available in Sri Lanka on vitamin D status in pregnant mothers. Vitamin D supplements are not provided routinely in state sector clinics. Institute of Medicine of the National Academy of Sciences in the USA recommends safe upper limit of dietary vitamin D as 4000 IU. Our aim of this study was to assess vitamin D status and adequacy of vitamin D intake through diet among pregnant mothers. This is a secondary analysis of data of a prospective cohort study. 89 pregnant mothers in their 3rd trimester were recruited. Food frequency questionnaire based on 7-day estimated food record method was used. Analysis of blood sample was done for vitamin D, parathyroid hormone (PTH), calcium, inorganic phosphorous and alkaline phophatase levels.Statistical analysis used Spearman's correlation and independent sample t-test were performed. We found that 12.4%, 50.6% and 37.1% were vitamin D deficient, insufficient and sufficient respectively. 25(OH)D and PTH showed a significant negative correlation (r=0.296; P<0.01). Yet, serum PTH level was above the cut-off only among 4.5%. Further, only 13.5% subjects had high ALP (>240 IU/L). Average daily intake of vitamin D through diet was 1289.4 ± 1225.6 IU/day (range 56 IU- 5400 IU). Significant Main source of vitamin D was fortified milk powder and small fish.. High rate of vitamin D insufficiency/deficiency was observed and this novel finding in our cohort suggests investigating vitamin D status in pregnant mothers at a national level. Vitamin D intake through diet was not adequate in our study sample. Further, rigorous trails are needed to evaluate the requirement for supplementation to optimise the bone metabolism during pregnancy in Sri Lanka.*

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INTRODUCTION

Vitamin D deficiency and insufficiency are common worldwide(1,2,3). Studies conducted in many countries lying within the tropics and subtropics have shown low vitamin D status(1). Overcrowding, atmospheric pollution, low availability or low affordability of vitamin D containing food and dress customs that limit skin exposure are main factors responsible for vitamin D deficiency. Some studies have revealed vitamin D deficiency is common in antenatal and lactating mothers(2,4) Higher 1,25-dehydroxy vitamin D levels during 2nd and 3rd trimesters and high fetal demand for calcium indicate that requirement for vitamin D during pregnancy is high(5).

Adverse maternal outcome of low vitamin D are documented(6,7,8). Pregnancy induced hypertension, recurrent miscarriages, gestational diabetes mellitus, premature delivery, and postpartum depression are some of them. A myriad of other metabolic/non-skeletal outcomes of vitamin D deficiency are identified and immune-modulatory and anti-infective properties are highlighted among them. In addition, certain studies have shown that vitamin D deficiency affect the health outcomes in the offspring(9).

A number of studies in the South East Asian region have evaluated the prevalence of vitamin D deficiency among pregnant mothers using a variety of different cut-off levels for 25-(OH)D(2,10). However, there is no consensus on optimum serum 25(OH)D during pregnancy. The Institute of Medicine (IOM) of the National Academy of Sciences in the USA has recommended cut off level for 25(OH)D sufficiency as >20ng/L, while the risk of vitamin D deficiency as <10 ng/L(11).

Daily requirement of vitamin D and calcium during pregnancy is controversial too. It has been shown in a randomized controlled trials that vitamin D supplementation in pregnancy could up to a safe dose of 2000-4000 IU/day(12,13,14). A number of reports have shown that 4000 IU/day of vitamin D a supplements is more effective in achieving satisfactory serum concentrations(13,14). IOM recommends safe upper limit of vitamin D and calcium in the diet as 4000 IU and 2500mg respectively. World Health Organisation recommends 1500-2000 mg of elemental calcium/ day as supplementation(15). Yet, the optimal dose of vitamin D and calcium for pregnant women is debatable(16).

Vitamin D occurs naturally in oily fish, egg yolk and fortified food products such as milk, margarine, vegetable oils and ready-to-eat breakfast cereals. Most of these food items are less affordable to lower socioeconomic class, in Sri Lanka. Further, vitamin D supplements are not provided routinely in state sector clinics. Thus, our aim of this study was to assess vitamin D status and adequacy of vitamin D intake through diet among pregnant mothers.

SUBJECT AND METHODS

This is a secondary analysis of data of a prospective cohort study investigating maternal vitamin D status in pregnancy and breast feeding and its effect on infant growth. This study was approved by Ethics Committee of Faculty of Medical Sciences, University of Sri Jayewardenepura. Pregnant mothers in their 3rd trimester were recruited from the obstetric department in Colombo South Teaching Hospital. Exclusion criteria were mothers already on vitamin D supplements, multiple pregnancy, serious medical problems (non-obstetric) and disability that could be related to bone metabolism. Convenient sampling technique was employed and all eligible mothers were invited for the study.

They were explained of the study procedure in small groups. Once the informed written consent was obtained, we collected data on demography, obstetric history, general health and past medical and surgical conditions, medications and nutritional supplements into a pre-tested interviewer administered questionnaire. Gestational age was based on last menstrual period and ultrasonography findings.

Food frequency questionnaire was designed and pretested to collect the details on diet. It was based on 7- day estimated food record method. In estimated food record method generally quantification of foods items and drinks are estimated rather than weighed. This was carried out using household measures such as cups or spoons and food photographs. Then estimates were converted into weights (grams). A trained investigator administered the food frequency questionnaire. Details were obtained on food brands and vitamin & mineral supplementation received. Dietary details were verified with reading the details back to each participant for accuracy and completeness. Estimation of dietary intake of vitamin D and calcium were performed with, Nutrisurvey 2007 modified for Sri Lankan food items and recipes(17,18). This is a software considering cooking procedures and locally available brands. Vitamin D content was measured in micrograms and converted to International Units (IU= micro grams/0.025). Dietary calcium levels were directly calculated in milligrams.

A trained investigator did a brief clinical examination of all eligible mothers. Blood samples were collected and serum was stored at -20˚C until analysis. 25(OH)D was measured by VIDAS® 25 OH Vitamin D Total, in serum using the Enzyme Linked Fluorescent Assay (ELFA). It is very well correlated to the Liquid Chromatography/Mass Spectrometry reference method with cross reactivity of 100% with 25(OH)D3 and 91% with 25(OH)D2. For analysis of calcium, inorganic phosphorus (IPh) and alkaline phosphatase colourimetric method was employed. DRG (EIA-3645), Intact-PTH ELISA was used for quantitative determination of intact-PTH in serum.

SPSS version-15 was used for statistical analysis. Results are presented for serum 25(OH)D, PTH, calcium and alkaline phosphatase as means and standard deviations. Serum concentrations of 25(OH)D of >20 ng/L (sufficient), 10-20ng/L (insufficient) and <10ng/L (deficient) were taken according to IOM classification. Correlation was performed using spearman correlation test. Serum levels were dichotomized as deficient/insufficient versus sufficient and comparison was done by independent sample t-test.

RESULT AND DISCUSSION

Results of 89 pregnant mothers were analysed. Majority (52%) had only primary education. Seventy one percent were housewives. Majority (61%) in our cohort fell into lower socio-economic class.

Average total daily intake of vitamin D was around 1289.4 ± 1225.6 IU/day (range 56 IU- 5400 IU). Significant proportion (45%) consumed <600IU of vitamin D per day. Main source of vitamin D was fortified milk powder and fish. Most (56.9%) of them received vitamin D though fortified milk powder and 36% from fish consumption. Most (69%) consumed small fish. None of them had vitamin D supplementation.

All mothers received calcium lactate as supplementation (300mg/day) from the booking visit at 12 weeks of gestation onwards. However, 2.2% of mothers did not take calcium. 5.6% of the subjects consumed only half the dose that was prescribed (150mg/day). Majority (92.1%) adhered to the prescribed dose. Daily dietary intake of calcium was 582.0 ± 384.0 mg/day (range 24.8-2060 mg). The average intake of total calcium intake (dietary calcium intake and supplementation together) was 870.2 ± 394.0 mg/day range (range 24.8 – 2360 mg/day). Only 6.7% of the subjects consumed calcium above the recommended levels (> 1500 mg/day).

Mean serum values for Vitamin D and bone biochemistry of the subjects are given in table 1. Of them, 12.4%, 50.6% and 37.1% of the population were vitamin D deficient, insufficient and sufficient respectively. However serum PTH level was (reference range 10.4- 66.5 pg/mL) above the cut-off only among 4.5%. Serum calcium was within the normal range in all. High level of alkaline phosphatase was found in 13.5% of the study population when(>240IU/L) cut-off is considered as >240IU/L[19].

Table 1: Vitamin D status and bone biochemistry of the respondents

Parameter	Mean (SD)
25 (OH)D (ng/mL)	18.7 (7.2)
Serum corrected calcium (mmol/L)	2.3 (0.2)
Alkaline phosphatase (IU/L)	180.8 (53.2)
Parathyroid hormone (pg/mL)	24.3 (22.8)
Inorganic phosphorus (mmol/L)	1.3 (0.2)

Relationship between vitamin D with bone biochemistry is shown in table 2. Serum vitamin D and PTH showed a significant negative correlation. However, there was no significant correlation between vitamin D and alkaline phosphatase or calcium.

Table 2: Relationship Between Vitamin D Status With Bone Biochemical Parameters

	Bone biochemical parameters			
	PTH	Calcium	ALP	IPh
Serum 25(OH)D	-0.296 (p=0.005)*	0.002 (p=0.983)	-0.168 (p=0.128)	0.189 (p=0.077)

*correlation significant at the level of0.001

We analyzed the relationship between dietary vitamin D intake and serum 25(OH)D levels. There was a significant correlation between dietary vitamin D and serum 25(OH)D (r=0.355, p<0.01). Dietary vitamin D intake was significantly differ between serum 25(OH)D deficient/insufficient (dietary vitamin D:1083.6±1026.4 IU/day) and sufficient groups (dietary vitamin D:1638.5±1456.1 IU/day) based on the independent sample t-test assessment

To our knowledge, this is the first study in Sri Lanka revealing the presence of vitamin D deficiency among pregnant women. Further, vitamin D status of most age groups is not verified in detail to date. Vitamin D deficiency/insufficiency was significantly high in this cohort and metabolic bone stress was demonstrated with a significant negative correlation of vitamin D to PTH. However, PTH level in majority, except for 3 subjects with insufficiency/deficiency of vitamin D were below the cut off value. Therefore our sample pregnant mothers with hypovitaminosis D did not show the expected rise of PTH. This has implications to define the optimum level of vitamin D in serum. Further studies should elucidate this research query. Although majority had low 25(OH)D, only 13.5% had high ALP that indicates biochemical osteomalacia. Since there is placental production of ALP, it is not a reliable marker of vitamin D status during pregnancy[16].

Estimated food records through food frequency questionnaire revealed that intake of calcium and vitamin D in diet are not optimal in most of the mothers. Natural sources of vitamin D are primarily oily fish, meat (beef & pork) and egg yolk. Oily fish is a common feature of traditional Sri Lankan diet. Thora (Spanish mackerel), Balaya (tuna), thalapath (sword fish), Salaya/Sudaya (Sardinella), Hurulla (Trenched sardinella) and mora (shark fish) are common types of oily fish in Sri Lanka[20]. However, sword fish and shark fish are not recommended during pregnancy due to high levels of mercury. Majority of mothers consumed small fish due to high availability and low cost. Large fish such as Spanish mackerel and sword fish are less affordable to lower socioeconomic class. Although it is relatively expensive in Sri Lanka, they consumed vitamin D mostly through fortified powder milk.

We have shown that vitamin D deficiency/insufficiency is not uncommon and dietary intake is significantly low in mothers with low serum 25(OH)D levels. State clinics in Sri Lanka have not included vitamin D supplementation as a part of antenatal care programme. Further, most of the vitamin D containing food items is less affordable to most. Therefore, vitamin D supplementation during pregnancy could be suggested an intervention to protect against adverse gestational outcomes. However, whether supplementation during pregnancy safely improves maternal and neonatal outcomes is still questionable since there are not adequate high quality studies confirming usefulness and safety. Recent Cochrane review has concluded that there is not enough evidence available to recommend the potential use of vitamin D in routine antenatal care[21]. Thus, it's clear that further trials studies are required to evaluate usefulness of vitamin D supplementation in pregnancy.

There were few limitations in our study. Firstly, although we used a pretested food frequency questionnaire based on a 7-day estimated food record method, it is liable to erroneous portion size estimation, dietary misreporting, and incorrect food description. However, it has lower respondent burden than weighed food diaries. Secondly, we could not report on the sun exposure which could have influenced the vitamin D levels.

CONCLUSION

We have reported high rate of vitamin D insufficiency/deficiency in our cohort of pregnant women from lower socioeconomic class. It is evident that diet alone may not be enough to achieve vitamin D status in pregnant women. These findings, together with existing data, emphasises the need for further evaluation of vitamin D status, re-defining the cut-off levels in pregnancy and evaluating the requirement of vitamin D supplementation routinely for pregnant women in Sri Lanka.

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