MATERNAL VITAMIN D LEVELS DURING 3RD TRIMESTER OF PREGNANCY, LACTATION AND THE RELATIONSHIP WITH VITAMIN D LEVEL OF THEIR OFFSPRING AMONG A SELECTED POPULATION OF MOTHERS IN SRI LANKA

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Introduction

High prevalence of vitamin D deficiency has been established among children and adults in tropics and sub tropics. Major source of vitamin D is sunlight. Some food items such as oily fish (salmon, mackerel, sardines; cod-liver oil), liver, other organ meats, egg yolks, fortified dairy products contain substantial amount of vitamin D. However, most food items that contain vitamin D are less affordable to most from lower socio-economic class. Inadequacy of sun exposure due to urbanization, environmental pollution and limited outdoor activity is reported as reasons for vitamin D deficiency [1]. Vitamin D plays a major role in calcium metabolism. It is also responsible for variety of other non skeletal functions such as immune functions, Preliminary, type 1 diabetes, cancers, respiratory illness, and psychiatric illnesses [2].

The consequences of vitamin D deficiency are likely to worsen during pregnancy because of the active trans-placental transport of vitamin D. Infants of vitamin D deficient lactating mothers are at risk of developing vitamin D deficiency as breast milk is a poor source of vitamin D [3]. Therefore, it is evident that requirement for vitamin D is higher in pregnant/lactating mothers and growing infants. Vitamin D supplementation is not included in the routine care of pregnant/lactating mother or infant in the state run clinics. In Sri Lanka, a study conducted in the Southern province among women in the reproductive age group, has shown that vitamin D deficiency (defined as < 10 ng/mL) as 40.5% [4]. Moreover, a study conducted to identify micronutrient status among urban preschool children in Ragama, Sri Lanka, has detected vitamin D deficiency in 5.6% of the population(defined as <10ng/ml) [5]. However, Vitamin D status of pregnant women, lactating mothers and infants in our country are lacking.

Thus, the objectives of this present study were to evaluate the maternal vitamin D levels during 3rd trimester of pregnancy, lactation and the relationship to neonatal vitamin D levels of the offspring.

Material and Methods

Mothers with multiple pregnancies, serious medical problems (non-obstetric), disabilities that could be related to bone metabolism, maternal pregnancy induced complications (pregnancy induced hypertension and gestational diabetes), premature delivery and offspring with congenital abnormalities were considered as exclusion criteria and excluded from final analysis.

Pregnant mothers (n=104) in their 3rd trimester attending obstetric clinic at Colombo South Teaching Hospital (CSTH) were invited for the study. Basic information was gathered by a pre-tested interviewer administered questionnaire after obtaining informed written consent. A brief physical examination including anthropometry was carried out. A blood sample was collected for analysis of vitamin D, parathyroid

hormone (PTH), calcium, alkaline phosphatase (ALP) and inorganic phosphorus at recruitment and follow up visits were arranged. These parameters are considered as measures of metabolic bone diseases and previous studies stated the relationship between these biochemical parameters. PTH and ALP inversely correlated to vitamin D levels whereas calcium and inorganic phosphorus showed positive correlation with vitamin D. Delivery details were taken from birth records. Mother and the baby were reviewed between 4-6 weeks after delivery. Reminders via telephone calls (maximum of 3) and a stipend for transport was provided for these parents. At the follow up visit in addition to clinical examination of the baby and the mother, blood samples were collected for biochemical analysis. Blood samples were transported in ice and stored at -20˚C after serum separation, until analysis.

Analysis of 25-(OH)D was done 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 Vitamin D_3 and 91% with Vitamin D_2. Inorganic phosphorous (IP), calcium and alkaline phosphatase (ALP) were measured using auto analyzer. The DRG (EIA-3645) Intact-PTH ELISA was used for quantitative determination of intact-PTH in serum. Statistical analysis was performed using SPSS (version 15.0) software package. Data analyses were done in two ways. Initially maternal and infant bone biochemistry was considered as continuous variables and correlation analysis was done. Data were log transformed where necessary. Subsequently, Spearman correlation was applied to assess the influence of maternal vitamin D on vitamin D status of the offspring. Secondly the maternal vitamin D levels were grouped according to the Institute of Medicine (IOM) of the National Academy of Sciences in the USA as 25 (OH)D < 10ng/mL as deficient, 10-20 ng/mL as insufficient and > 20ng/mL as sufficient levels. Then one-way ANOVA was performed. Results were presented as mean ± standard deviation (SD). Statistical significance was considered at 95% confidence interval ($p<0.05$).

Results and Discussion

Mean age of the maternal population was 29±6 years. Majority of the mothers were housewives (81.7%). Half of the population (54.8%) had only primary education. The mean gestational age at birth was 38.8±1.2 weeks and mean age of the infants at follow up was 37±7 days. Majority (53/104) were girls.

The biochemical parameters of both mother and the infant are given in the table 01. Serum calcium and inorganic phosphorus were in the normal range. Although mean PTH was in the normal range despite having vitamin D deficiency, it showed a significant negative correlation with vitamin D levels in both mothers and infants; pregnancy ($r=-0.292;p<0.01$), lactation ($r=-0.247;p<0.05$) and infancy ($r=-0.280;p<0.01$).

Table 01: Vitamin D status and bone biochemical parameters of the population

Biochemical Parameters	Pregnant mothers	Lactating mothers	Infants mean ± SD
Corrected calcium (mmol/L)	2.29±0.16	2.17±0.10	2.52±0.10
Inorganic phosphorous (mmol/L)	1.32±0.21	1.30±0.22	2.14±0.20
ALP (IU/L)	194±172.7	121.1±25.5	415.7±107.6
PTH (pg/mL)	23.8±22.1	41.3±38.3	28.6±23.0
Vitamin D (ng/mL)	18.6±7.2	20.6±7.0	11.4±5.6

We investigated the relationship between mothers' vitamin D values with infant vitamin D levels both by spearman correlation and ANOVA (after dichotomizing mother's vitamin D levels into 3 groups).

Spearman correlation showed a significant linear relationship between mother's vitamin D both in pregnancy ($r=+0.486$; $p<0.05$) & lactation ($r=+0.489$; $p<0.05$) with infant vitamin D status.

Dichotomization was done according to IOM classification (table 2). 14.4% and 5.8% mothers had vitamin D deficiency during pregnancy and lactation respectively. Majority of the infants had vitamin D deficiency (Table 2). Subsequently, one-way ANOVA was performed to study the relationship between vitamin D statuses of the infant against maternal vitamin D levels according to IOM grouping (Table 3). Infant vitamin D levels were in the normal range when the maternal vitamin D was sufficient. Thus deficient mothers (both in pregnancy & lactation) are more likely to have deficient infants.

Table 2: The distribution of vitamin D levels in the study population

Vitamin D level	Pregnant mothers n (%)	Lactating mothers n (%)	Infants n (%)
Deficient	15 (14.4)	06 (5.8)	67 (64.4)
Insufficient	51 (49.0)	46 (44.2)	25 (24.0)
Sufficient	38 (36.5)	52 (50.0)	12 (11.6)

Table 3: Distribution of infant vitamin D levels among maternal vitamin D grouping

	Infant vitamin D levels (Mean ± SD) ng/mL	One-way ANOVA
Pregnancy		
Deficient	8.36±1.33	F value : 11.127
Insufficient	10.02±4.42	P = 0.000
Sufficient	14.46±7.72	
Lactation		
Deficient	9.73±2.69	F value : 5.762
Insufficient	9.59±4.48	P = 0.004
Sufficient	13.20±6.25	

Conclusions and Recommendations

High level of vitamin D deficiency was observed among infants in the study population. Majority of the mothers were either deficient/insufficient with regard to their vitamin D levels. Most importantly, maternal vitamin D status influences the infant vitamin D level; deficient mothers may have deficient infants. These findings together with existing data emphasise the need for further assessment of vitamin D status and evaluation of the requirement for vitamin D supplementation in a nationally representative sample. Thus, research in this area needs support and funding from governmental and non-governmental organizations to obtain a comprehensive picture of vitamin D status in all age groups.

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