Prevalence of vitamin D deficiency in a North London antenatal population

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Summary

Objective: We evaluated the prevalence of vitamin D deficiency in the antenatal patients attending North Middlesex University Hospital between March 2008 and March 2009.

Study design: A prospective study of maternal levels of vitamin D at booking.

Results: The prevalence of both deficient and insufficient levels of 25[OH]D was 87.6% across all included patients.

Conclusion: There is a high prevalence of asymptomatic vitamin D deficiency in the antenatal booking population.

Keywords: antenatal care, vitamin D deficiency, high-risk pregnancy, maternal–fetal medicine

INTRODUCTION

Vitamin D is a fat-soluble vitamin which has a beneficial effect on bone health and has been suggested to have a role in cell growth and immunity. Calcium levels in adults depend heavily on concentration of vitamin D, and its deficiency in pregnancy may lead to impairment of fetal skeletal formation and increase chronic disease susceptibility.^{1–3} The fetus accumulates about 30 g of calcium from the mother *in utero*, and 80% of this transfer occurs in the last trimester of pregnancy.

The majority of vitamin D in the human body is derived from the action of ultraviolet (UV) B light on 7-dehydrocholesterol in the skin. A smaller proportion comes from dietary sources. Vitamin D in the skin is biologically inert and undergoes conversion to 25-hydroxyvitamin D3 in the liver and then in the kidney to 1,25-dihydroxyvitamin D3.

The amount of UV B light that reaches the skin depends on latitude, season and the actual amount of sun exposure.⁴ People with darker skin produce less vitamin D for a given sunlight exposure, and veiled women or those with modest dress code, regardless of the climate, have a reduced skin exposure to sunlight. An Australian study looking at dark-skinned women and/or veiled pregnant women found that 80% were vitamin D deficient.⁵ Even in the USA where a variety of food is fortified with vitamin D and the use of prenatal vitamin supplements is high, recent studies have shown significant vitamin D deficiency in black women.^{6,7} A Dutch study in 2007 suggested that babies born to mothers with dark skin and those who are veiled were more likely to have low levels of vitamin D in cord blood.⁸

Studies in 2006 and 2009 have shown a worrying increase in the prevalence of vitamin D deficiency in pregnant women globally. This problem is no longer confined to veiled women or those with dark skin, although this cohort remains at highest risk,^{9,10} even in the sunniest of climates.^{11,12}

At North Middlesex University Hospital (NMUH) in London, we had also noticed an increase in the incidence of vitamin D deficiency-related morbidity in both our preterm and term infants. NMUH serves an extremely diverse population of pregnant women with many refugees and asylum seekers. The maternity unit cares for approximately 3500 women a year. The hospital serves a borough where more than 50% of the local population is black and/or from ethnic minorities. The area served by NMUH is of a low socioeconomic classification with a standardized mortality ratio of 110 compared with 99 in the rest of England with a model-based estimate for consumption of fruit and vegetables of 27.8%.¹³ This, therefore leads this population vulnerable to nutritional deficiencies. This is compounded by cultural practices such as decreased exposure to sunlight either as a result of clothing, and/or lifestyle as 11.26% of the local population classify themselves as Muslim, compared with the national average of 3.1%.¹³

OBJECTIVES

The aim of the study was to determine the prevalence of vitamin D deficiency in the women attending the antenatal clinic at NMUH, London. We were particularly interested in the demographics of those women affected with low levels which may then translate to vitamin D deficiency in the neonates' cord blood. This paper discusses the preliminary results with respect to vitamin D levels at booking.

PATIENTS AND METHODS

This was a prospective study of maternal levels of vitamin D at booking. Recruitment took place from March 2008 to March 2009. Women were invited to join the study at their initial booking appointment with the midwife. Inclusion criteria were any woman booking for antenatal care at the hospital irrespective of their ethnicity, parity, age and cultural belief. Women with vitamin D deficiency who were already receiving supplements were excluded.

All mothers were provided with an information leaflet with regard to the aims of the study and formally consented to take part. For non-English speakers, interpreters were employed. The study had ethics approval from the local Research and Ethics Committee and that of Great Ormond Street Hospital. Maternal demographics including age, ethnicity, country of birth, special dietary requirements and body mass index were recorded. Past medical history, current medication, parity and gestation at booking were obtained from the hospital PROTOS maternity database and hospital notes. The women were followed from the time of antenatal booking until delivery. Blood tests were done at booking, 28 weeks and at 36 weeks. Cord blood was analysed from the biochemical parameters associated with vitamin D deficiency.

Vitamin D was measured by liquid chromatography/mass spectrometry and results obtained through the biochemistry laboratory database. Vitamin D deficiency was diagnosed when the 25[OH]D level was <50 nmol/L.

Pearson's correlation was used to examine demographic variables and Mann-Whitney and Kruskal-Wallis test for categorical demographics.

RESULTS

We recruited 368 women during this period. The ethnic mix of this group was varied with Africans comprising the largest group with 32% ($n = 118$), and of these 22% ($n = 26$) were Somali. The most recent local population census estimated the proportion of black or black British people to be 17.8%.¹³ The next largest group of 31% ($n = 115$) were white European including those born in the UK. There is a significant Turkish population in this catchment area and this was reflected in our study cohort, with 10% ($n = 36$) of women originating from Turkey. We found that for the majority of women, 92% ($n = 340$), their documented ethnicity matched their country of birth. Of the 8% ($n = 28$) born outside the country of their ethnic origin, 93% were black African or black Caribbean and born in the UK.

With regard to body mass index (BMI), 3% ($n = 10$) were underweight with a BMI of <18.5 . Fifty-two percent ($n = 190$) were in the healthy weight category (BMI 18.6–24.9), 26% ($n = 97$) were overweight with a BMI between 25 and 30 and 17% ($n = 64$) were obese with a BMI recorded as over 30. We were unable to calculate the BMI for 2% ($n = 7$) due to missing data. In our population, there was a negative association between BMI and vitamin D levels in the first ($P = 0.11$) and second ($P = 0.04$) trimesters. The BMI between the ethnic groups differed, but interestingly there was no relationship between the BMI and vitamin D levels based on ethnicity and this may be due to the smaller numbers in the individual groups.

In our groups, the lowest vitamin D levels were noted in the Asian women, who interestingly had the lowest BMIs while the black women had the highest BMI. None of the groups had mean BMIs that fell into the obese category.

During the booking consultation, women were asked to specify any special dietary requirements. Only four patients (1%) were documented as being vegetarian, there are wide ranging values in the literature regarding the prevalence of people with vitamin D deficiency with vegetarian diets in the UK, from 5% to 11%.¹⁴ Only one woman was documented as taking multivitamins and she was found to have sufficient vitamin D levels. She was not included in the data-set given the aforementioned exclusion criteria. There was no significant difference between vitamin D levels and the small number of women on a special diet ($P = 0.32$).

Forty-five percent ($n = 164$) of our study cohort were nulliparous with the remainder having had previous deliveries.

The national recommendation is that all women should book for antenatal care before 12 weeks gestation; however, in our study only 49% ($n = 179$) of the patients had booked in the first trimester. This is perhaps explained by the low socioeconomic and multicultural population where a lack of health education and cultural expectations affect health-seeking behaviour.

Of the 368 women recruited to the study, 56% ($n = 207$) had their bloods taken and analysed for vitamin D at booking. Of these women we found that 56% ($n = 115$) were deficient (levels <25 nmol/L) of vitamin D. A further 32% ($n = 66$) had insufficient (levels of 25–50 nmol/L) and only 12% ($n = 26$) had sufficient levels (>50 nmol/L) of vitamin D at booking.

Table 1 details the percentage of those deficient in different ethnic groups. None of the women had been labelled as vitamin D deficient prior to pregnancy. The highest vitamin D levels were found in white women with both black and Asian women having lower levels ($P < 0.001$). Although the overall levels of vitamin D deficiency in our cohort were surprising, the increased prevalence in recognized high-risk groups (i.e. dark-skinned/veiled women) correlates with the published data.

DISCUSSION

The latest National Institute for Health and National Institute for Clinical Excellence (NICE) recommendation (Antenatal Care: Routine Care for the Healthy Pregnant Woman. Guideline 62, Mar 2008), is to inform all pregnant women about the importance of maintaining adequate vitamin D stores during pregnancy and while breast feeding. In order to achieve this woman may choose to take 10 $\mu\text{g}/400$ U of vitamin D per day. Women at highest risk of vitamin D deficiency are defined as those of south Asian, African, Caribbean or Middle Eastern family origin, those who have limited exposure to sunlight, and those on low vitamin D diets, and women with a prepregnancy BMI above 30 kg/m^2 .

Our study showed that a significant proportion of all women attending the antenatal clinic at the NNUH are vitamin D deficient. This was an extremely unexpected finding as it highlights that this is a greater problem than described previously. We were surprised to find that 34% of the women who were deficient would have previously been defined as 'low risk for vitamin D deficiency'. This includes 'white' women, who were born and brought up in Britain. Few studies have looked at this low-risk women group and their levels of vitamin D deficiency. We consider this to be an extremely significant finding as it highlights that vitamin D deficiency/

Table 1 Vitamin D deficiency in the different ethnic groups booking bloods

Ethnicity	Deficient (<25)	Insufficient (<50)	Sufficient (>50)	Total	% Deficient (insufficient and deficient)
African	32	18	1	51	62.7 (98)
Somalian	9	2	0	11	81.8 (100)
Black Caribbean	13	5	0	18	72.2 (100)
Mixed	5	1	0	6	95.3 (100)
White British	4	11	10	25	16% (60)
Turkish	18	5	0	23	78.3 (100)
White European	10	18	13	41	24 (68)
Asian	16	3	0	19	84.2 (100)
Chinese	3	3	2	8	37.5 (75)
Any other	5	0	0	5	100 (100)

insufficiency affects all ethnic groups and screening and supplementation should also include those considered low risk previously. For the non-pregnant 'low-risk' population, vitamin D deficiency should be considered a possibility on the basis of symptoms and appropriate testing undertaken.

At NMUH, akin to other local units, we do not have a guideline for offering vitamin D supplementation. If we chose to supplement only women considered high risk according to NICE we would miss a significant proportion of affected women. Studies looking at the UK population as a whole indicate that more than 50% of the adult population may have insufficient levels of vitamin D.¹⁵ Those looking at neonatal levels point to more than 20% of babies being vitamin D deficient in unsupplemented mothers.¹⁶

Our study is unique in that all booking women regardless of ethnic origins were recruited. Studies of similar size from a UK pregnant population have thus far been lacking. The demographics of antenatal patients as a whole are changing and with increased immigration our data may be generalized to other parts of the country.

A recent paediatric audit in London had shown a prevalence of 1.6 per 1000 deliveries of symptomatic vitamin D deficiency in infancy. Of these babies, 49% were hypocalcaemic at presentation and 27% had hypocalcaemic seizures.¹⁷ Despite NICE recommendations, the absence of local departmental guidelines on vitamin D supplementation in pregnancy is widespread. The study by Yu *et al.*¹⁸ has shown that even in the group receiving supplementation (200,000 IU stat dose/800 IU daily supplement) with vitamin D, only 30% of treated women and 8% babies achieved normal vitamin D levels. Hence, despite the introduction of antenatal guidelines, there remains a pressing need to identify both the right dose and timing of vitamin D supplementation.

CONCLUSION

There has been considerable debate about the relevance of deficiency or insufficiency of vitamin D levels and at what point intervention is warranted. It is our opinion that these are not two separate categories but a continuum. As with all deficient states, if supplementation is not received, levels will continue to drop with increasingly severity of symptoms. This research originated after observations of seizures mainly in breast-fed neonates and bone disease in some premature infants on the Special Care Baby Unit. Breast milk has little vitamin D even when maternal levels are adequate.¹⁹ Thus infants who are already low will gradually become more depleted of vitamin D and symptomatic even in the absence of hypocalcaemia.

Adequate vitamin D levels in the mother will provide normal cord blood concentrations in babies. Following recommendations on decreasing vitamin D deficiency in pregnancy will reduce deleterious effects on babies both in the short and long term.²⁰ We will shortly be analysing our data with regard to vitamin D levels in the different trimesters of pregnancy and the correlation to levels in cord blood.

Low maternal vitamin D levels is a significant public health issue and we hope this paper will add further to raise awareness on this subject among all health-care providers. A positive outcome of this research is that more attention is being paid to the importance of vitamin D in pregnant women in our catchment area. The cost implication of a screening programme is under debate, and so supplementation is key.

This study highlights the need to urgently review the current recommendations as higher doses and longer duration of prenatal multivitamins may be required.

Further work is needed to introduce guidelines for vitamin D supplementation in pregnancy, and audit the efficacy following implementation. Lessons need to be learnt in how best to identify, inform and educate women at highest risk of delivering babies with vitamin D deficiency as this deficiency may be largely preventable if appropriately addressed.

Patient education, counselling and support however will be of utmost importance in our general antenatal population. Vitamin D supplementation in pregnancy may be low despite treatment being offered due to lack of compliance.²¹ Follow-up studies are required to show the effect of widespread supplementation.

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