

Relationship between Maternal Vitamin D Deficiency and Low Neonatal Birth Weight

Thesis

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List of Abbreviations

<i>Abbrev.</i>	<i>Full term</i>
25(OH)D	: 25-Hydroxyvitamin D
AGA	: Average for gestational age
ALSPAC	: Avon-longitudinal study of pregnancy and childhood
ASD	: Autism spectrum disorder
BMC	: Bone mineral content
BMI	: Body mass index
BPD	: Broncho-pulmonary dysplasia
CA2+	: Calcium
CBP	: Central blood pressure
CI	: Confidence interval
CNS	: Central nervous system
D2	: Ergocalciferol
D3	: Cholecalciferol
DM	: Diabetes mellitus
DNA	: Deoxyribonucleic acid
DXA	: Dual energy X-ray absorptiometry
ECLIA	: Electrochemiluminescence immunoassay
EISA	: Enzyme linked immunosorbent
EIBW	: Extremely low birth weight
EONS	: Early-onset neonatal sepsis
FAS	: Fetal alcohol syndrome
GC	: Gas chromatography
GDM	: Gestational diabetes mellitus
GW	: Gestational weight

List of Abbreviations

<i>Abbrev.</i>	<i>Full term</i>
HDL	: High density lipoprotein
Hgb	: Haemoglobin
IOM	: Institute of Medicine
IQ	: Intelligence quotient
IQR	: Interquartile range
IU/D	: International unit per day
IUGR	: Intrauterine growth restriction
LBW	: Low birth weight
LC-MS/MS	: Liquid chromatography tandem mass spectrometry
LDL	: Low density lipoprotein
LGA	: Large for gestational age
LMP	: Last menstrual period
LOESS	: Locally weighted scatter plot smoothing
MAVIDOS	: The Maternal Vitamin D Osteoporosis Study
Mg/dl	: Milligrams per deciliter
MUSC	: Medical University of South Carolina
n	: Normal
NBW	: Normal birth weight
ng/dl	: Nanograms per deciliter
ng/ml	: Nanograms per millimeter
nmol	: Nanomoles per liter
OR	: Odds ratio
PG	: PrimiGravida
PTB	: Preterm birth

List of Abbreviations

<i>Abbrev.</i>	<i>Full term</i>
PTH	: Parathyroid hormone
PTH-rP	: Parathyroid hormone related peptide
R	: Correlation coefficient
RCT	: Randomized controlled trial
RDA	: Recommended dietary allowance
RR	: Relative risk
RTIs	: Respiratory tract infections
SD	: Standard deviation
SGA	: Small for gestational age
SNPs	: Single-nucleotide polymorphisms
T2D	: Type 2 diabetes mellitus
US	: Ultrasound
UVB	: Ultraviolet beam
VDAART	: Vitamin D antenatal asthma reduction trial
VDBP	: Vitamin D binding protein
VDRs	: Vitamin D receptors
VIDAS	: Vitek Immunodiagnostic Assay System
VLBW	: Very low birth weight
WHO	: World Health Organization
WIC	: Women, infants and children (Public Health Program)
Wt/Ht	: Weight over height squared

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ABSTRACT

Background: low birth weight (LBW) refers to term or preterm neonates with birth weight < 2500 gr. Neonates here may be small for gestational age or have intrauterine growth restriction. Mortality rate in such neonates is 40 times more than neonates with normal weight.

Aim of the Work: to investigate the relationship between maternal vitamin D deficiency and low birth weight in Ain Shams University Maternity Hospital.

Patients and Methods: our study is a cross-sectional case-control study which conducted at labor ward of Ain Shams Maternity Hospital from February to May 2018, it included 70 term neonate with birth, weight, 35 of them are low birth weight; (normal birth weight: 2500gm-4200gm). Among normal healthy single term pregnant women (37-40 weeks), whose ages vary from 20-35 years old and BMI between 18.5-24.9 kg/m²; after excluding of eclampsia or preeclampsia, DM, polyhydramnios or oligohydramnios, multiple pregnancies, systemic and chronic diseases, anemia (Hgb < 10.5 mg/dl), drug abused or smoking and congenital fetal malformation or infection. Just after delivery, 2 cm of maternal venous blood withdrawn from the 70 pregnant women to make routine complete blood count to exclude anemia, then just after delivery, 2 cm of maternal blood withdrawn to assess maternal 25 Hydroxy vitamin D status using ELISA technique.

Results: our study showed the strong relation between maternal vitamin D status during healthy pregnancy and birth outcome birth weight. Results here revealed that maternal hypovitaminosis D is associated with low birth weight of term fetuses, this association was confirmed in many previous studies with different races and populations.

Conclusion: Maternal vitamin D level should be measured during pregnancy and any deficiency should be considered to decrease incidence of low birth weight.

Keywords: *Vitamin D - Neonatal Birth Weight*

Introduction

Low birth weight (LBW) refers to term or preterm neonates with birth weight < 2500 gr. Neonates here may be small for gestational age or have intrauterine growth restriction. Mortality rate in such neonates is 40 times more than neonates with normal weight (*Martin et al., 2005*).

A systematic review of literature highlighted the effect of vitamin D on birth weight (*Thorne-Lyman and Fawzi, 2012*). Vitamin D (vitamin D) has a key role in fetal growth by its interaction with parathyroid hormone and calcium homeostasis. Studies confirmed that insufficient prenatal and postnatal levels of vitamin D have great effects on poor bone mineralization which have significant association with small for gestational age (SGA) births (*Karim et al., 2011*). SGA births are reported more frequent in pregnancies occurring in the winter with vitamin D deficiency (*Ford, 2011*).

High Prevalence of vitamin D deficiency (about a billion) has been seen among people all over the world (*Sioen et al., 2012*). Despite abundant and strong sunlight in Egypt in most days of the year, vitamin D deficiency is a common problem among adult women due to their clothing style and lack of seasonal food (*Khalessi et al., 2015*).

Aim of the Work

The aim of the current study is to investigate the relationship between maternal vitamin D deficiency and low birth weight in Ain Shams University Maternity Hospital.

Low Birth Weight

Introduction:

Low birth weight is one of the main risk factors for infant morbidity and mortality. When considering a fetus that is small for its gestational age, it is important to differentiate whether this is due to intra-uterine growth restriction (IUGR), prematurity or other constitutional factors (*Baghianimoghadam et al., 2015*). Although prematurity has historically been defined (American Academy of Pediatrics, 1935) as the birth of a live infant weighing 2500g or less, experience in clinical practice showed that many of these infants were not actually premature, but rather full-term fetuses from a pregnancy in which growth had been limited due to different factors. In 1967 the World Health Organization (WHO) recognized this fact, designating infants weighing 2500 g or less as low birth weight (*Gebregzabiherher et al., 2017*).

These growth chart guidelines for preterm, LBW, and VLBW infants were developed to ensure the consistency and accuracy of growth assessments of premature infants performed by WIC agencies. The use of weight, length, and head circumference measurements as a component of nutritional assessment is well established (*Harris, 2015*).

Plotting measurements on growth charts allows comparisons with reference populations. Serial measurements

enable determination of improvement or alteration in individual growth patterns (*Khadilkar and Khadilkar, 2011*). Ideal growth rates and patterns for preterm infants have yet to be established. Specialized reference curves commonly used (e.g. Babson/Benda, Lubchenco, etc.) are not based on current medical and nutritional advances in treatment of these infants. Updated reference curves are needed for assessing intrauterine and extrauterine growth for premature LBW and VLBW infants (*Cole, 2012*).

Growth and a composition of weight gain at a rate similar to that of intrauterine (fetal) growth is considered by some to be the gold standard for premature infants. However, controversy exists over the feasibility of replicating intrauterine growth on an extrauterine basis (*Rasmussen et al., 2009*).

LBW infants are a heterogeneous group that includes premature infants who have attained weight, length, and proportionality that are appropriate for their gestational age, as well as infants who are small for their gestational age (SGA). Infants who are born small for their gestational age may be preterm or full-term. Premature infants usually fall in the lower percentiles before adjusting for gestational age. For convenience, the following classifications are provided (*Ment and Vohr, 2008*).

Classification Definitions (*Guidelines for Growth Charts, 2017*):

➤ **Gestation:**

- Preterm less than 37 weeks gestation
- Postterm greater than 42 weeks gestation

➤ **Birth Weight:**

- Extremely low birth weight (ELBW) less than 1000 grams
- Very low birth weight (VLBW) less than 1500 grams
- Low birth weight (LBW) less than 2500 grams

➤ **Size for Gestational Age:**

- Small (SGA) weight less than 10th percentile
- Appropriate (AGA) weight greater than or equal to 10th percentile and less than or equal to 90th percentile
- Large (LGA) weight greater than 90th percentile

Low birth weight and blood pressure: increased cardiovascular risk

Birth weight is inversely related to blood pressure in men and women. Age greatly impacts the risk of high blood pressure in LBW women and accelerated weight gain in early life adds to the risk (*Alexander et al., 2014*). It is well established that within the general population men have a higher blood pressure than women prior to menopause