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Original Research Article

Effect of Maternal Weight Gain during Pregnancy on Umbilical Cord Blood Lipid Profile

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Conflict of interest: Nil

Abstract

Background: It is well established that fetal development is influenced by maternal factors and adverse intrauterine exposures. However, data regarding effect of these factors on fetal lipids is limited. As deranged fetal lipid profile is proposed to predispose to atherosclerotic Cardiovascular Diseases (CVDs) in later life, we planned to study effect of Maternal Weight Gain During Pregnancy (MWGDP) on Umbilical Cord Blood (UCB) Lipid Profile (LP).

Material and Method: A hospital based cross sectional study including 200 neonates and their mothers satisfying inclusion criteria was performed. Both maternal and fetal data were collected from Out Patient Department (OPD)/In Patient Department (IPD) case files as well as Hospital Information System (HIS)/Laboratory Information system (LIS). We categorised mothers of neonates enrolled in our study according to Prepergnancy Body Mass Index (PPBMI) and respective MWGDP in three groups (low, normal and high MWGDP). The UCB samples were analysed for LP in order to compare Umbilical Cord Blood Lipid Profiles (UCBLP) among the groups of mothers based on MWGDP.

Result: As the participants with high MWGDP were few, we excluded them from further analysis. In our study, neonates whose mother had low MWGDP, had more atherogenic UCBLPs (statistically significant higher levels of TC and LDL-C (with P values of 0.045 and 0.001, respectively) while statistically significant lower levels of HDL-C (P value of 0.0001) as compared to neonates whose mother who had MWGDP.

Conclusion: The results suggest that low MWGDP has deleterious effect on UCBLP resulting in more atherogenic lipid levels. Confirmation of this association with the help of further studies might provide in development of better screening protocols aiming at prevention of future life cardiovascular risks.

Keyword: Umbilical cord blood lipid profile, Maternal Weight, Maternal body mass index, Weight Gain During Pregnancy, Neonatal dyslipidemia

Introduction

Cardiovascular disease (CVDs) is the primary cause of mortality and morbidity. [1] The Fetal programming hypothesis claims that the underlying pathology responsible for various diseases starts in fetal life itself. [2] Studies suggest that fetal adiposity is influenced by maternal factors and related adverse intrauterine exposures. [3] As women in our country are prone to undernourishment, the role of maternal malnourishment and subsequent metabolic derangements in predisposition to adulthood diseases should be investigated. [4,5]

The maternal malnutrition and adverse intrauterine events during the crucial phase of fetal development can programmes the fetus resulting in adaptations that imprints the development of fetal tissues and organs. [2-4] This phenomenon is more relevant to developing countries like India, where women are chronically malnourished especially in rural areas. [4]

Lipid profile (LP) is a marker of the lipid metabolism and cardiovascular status. [5] Umbilical Cord Blood (UCB) lipids and lipoproteins are supposed to reflect the status of plasma metabolism during the fetal life. [6,7] Several studies suggested that adverse intrauterine exposures are linked with a higher prevalence of atherosclerotic CVDs in later life. [2,3] Therefore, this study was planned to explore the effect of Maternal Weight Gain During Pregnancy (WGDP) on UCBLP.

Materials and Methods:

A hospital based cross sectional study was carried out after obtaining permission from institutional research committee. The study included 200 mothers and their neonates delivered with singleton pregnancy at Kasturba Hospital, Mahatma Gandhi Institute of Medical Sciences (MGIMS), Sewagram, Wardha, Maharashtra from 1st July 2012 to 31st July 2014. All neonates and their mothers were enrolled after obtaining informed consent.

Mothers with twins or multiple pregnancy or conditions like addictions, medical or obstetric diseases as well as neonates with one minute APGAR score < 7 or with congenital feto-placental anomalies were excluded. [2,3,5-12]

If any one of the two (mother or neonate) failed to satisfy the inclusion and exclusion criteria, both were excluded. The comprehensive history, findings on physical examination of both mother and neonates and the results of UCBLP were recorded in specially designed proforma. Prepregnancy maternal weight and height and MWGDP were recorded. Prepregnancy Body Mass Index (PPBMI) was calculated using formula recommended by Centers for Disease Control and Prevention, Unites State Public Health Service. [13] We categorised women into low, normal and high MWGDP based Institute of Medicine and National Research Council "Committee to Re-examine IOM Pregnancy Weight" Guidelines according to their PPBMI and respective MWGDP. [14] UCB sample of neonates were collected immediately after delivery and analysed for LP at our Clinical Biochemistry Laboratory. LP estimation was done on ERBA EM360 Random Access fully automated analyzer using compatible reagent kits and protocols by ERBA Diagnostics Mannheim GmbH, Germany following the standard operating procedure of our laboratory by following methods:

1. Total Cholesterol (TC) by CHOD-PAP method [15]
2. Triglyceride (TG) by GPO-Trinder method [16]
3. High Density Lipoprotein Cholesterol (HDL-C) by Modified PVS and PGME coupled method [17]
4. Low Density Lipoprotein Cholesterol (LDL-C) and Very Low Density Lipoprotein Cholesterol (VLDL-C) levels were calculated using Friedwald equation [18]

With appropriate statistical methods, comparison of UCBLP among the groups of mothers based on MWGDP was done by SPSS 23.0 using student unpaired t test for the difference between two means and $p<0.05$ was considered as level of significance.

Results

After screening of 312 mothers and neonates we enrolled 200 neonates and their mothers in the present study based of our inclusion and exclusion criteria. Among the mothers, 4 had with multiple pregnancy, 24 were tobacco addicts, 4 had pre existing medical diseases while 5 were diagnosed with obstetric diseases. Among the neonates, 4 had one minute APGAR score < 7 while 1 was diagnosed with congenital anomaly. 70 mother and their neonates were excluded because of incomplete data (in most of cases missing prepregnancy weight and height) either in their case files or our Hospital Information System. Neonates were categorised according to their mothers' PPBMI and MWGDP for respective low, normal and high PPBMI, into low, normal and high MWGDP based on recommendation of Institute of Medicine and National Research Council Committee. [14]

Figure 1 shows the distribution of women as per their PPBMI and MWGDP according to respective low, normal and high PPBMI.

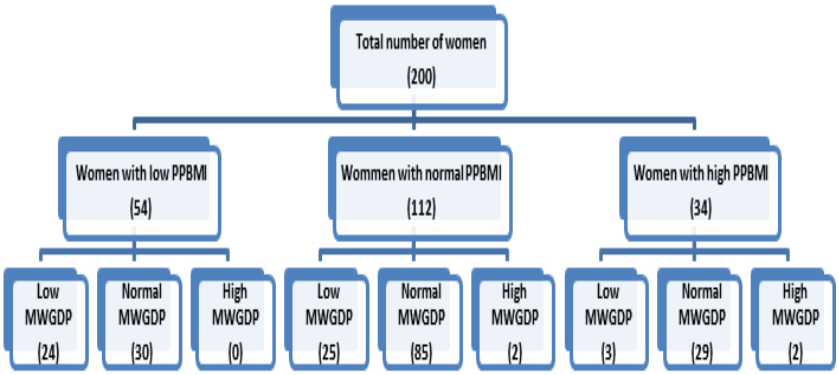

Figure 1: Distribution of women as per their PPBMI and MWGDP

As the numbers of women in high MWGDP were few, we excluded this group from further analysis.

Table 1 shows the results of comparison of UCBLP in normal and low MWGDP groups.
As the participants with high MWGDP were few, we excluded them from further analysis.

Table 1: comparison of UCBLP in normal and low MWGDP groups

Lipid Profile	Low MWGDP	Normal MWGDP	t-Value	P-Value
TC	86.95±11.79	83.65±12.27	1.711278	**0.045684**
TG	77.65±9.73	75.32±8.72	1.520352	**0.066601**
HDL-C	25.03±3.64	27.36±4.09	-3.825499	**0.000119**
LDL-C	46.45±9.09	41.83±10.93	2.970696	**0.001888**
VLDL-C	15.65±2.79	15.03±2.64	1.393015	**0.083726**

As per the Table 2, neonates whose mother had low MWGDP, had more statistically significant higher levels of TC (P value 0.045) and LDL-C (p value 0.001) while statistically significant lower levels of HDL-C (P value 0.0001) in UCBLP as compared to neonates whose mother who had MWGDP. The levels of TG and VLDL-C were found to be statistically insignificant (with P values of 0.066 and 0.083, respectively)

Discussion:

In our study population, we observed 27, 56 and 17 percent mothers had low, normal and high PPBMI, respectively (figure 1). Other studies in rural population of India have reported similarly high prevalence of low PPBMI [19] As per figure 1, 44.44 and 55.55 percent mothers among low PPBMI had low and normal MWGDP, respectively. None among the low PPBMI gained high MWGDP. 22.32, 75.89 and 1.78 and percent women among normal PPBMI gained low, normal and high MWGDP, respectively (figure 1). According to figure 1, 8.82, 85.29 amd 5.88 and percent had low, normal and high MWGDP among high PPBMI group, respectively. According to this, overall 26, 72 and 2 percent women gained low, normal and high MWGDP, respectively. Other studies have also reported similar prevalence of low MWGDP in rural population. [20] These findings point towards the higher prevalence of under nutrition in pregnant women of India, especially in rural areas. These observations also emphasize on the need for special attention for these women and their neonates. [4]

From the results of this study we propose that low MWGDP have impact on UCB lipids. These maternal factors are responsible for atherogenic UCB lipid levels (increased LDL-C while decreased HDL-C). These observations suggest the role of maternal factors in fetal programming triggering dyslipidemia at birth itself that results in adulthood CVDs. [3,6,8-12] Based on this we propose these factors might predispose these neonates to adulthood CVDs. [2] However these findings needs to be validated by further studies specifically planned to analyze the effect of PPBMI and MWGDP on UCBLP.

Based on these observations we propose that cord blood lipid screening of neonates with maternal factors that are known to affect fetal growth should be done. [21] Further, early diagnosis followed by prudent management of these neonates at risk of dyslipidemia in later life can be helpful in the primary amelioration of risk factors and thus a chance of preventing of CVDs in adult life. [2,3,6,8-12,21-23] However further prospective studies, following these high-risk neonates to confirm the prevalence of dyslipidemia in adulthood and incidence of CVDs are required to validate this assumption.

The observations of our study indicate that the maternal factors may trigger the processes responsible for predisposition to CVDs in the later life. [2,3,68-,13,21,23] These findings highlights that the effect of these maternal factors on fetal metabolic profiles manifests at fetal life itself (altered UCBLP in this case). Our study calls to

attention that some risk factor for CVDs in later life could be diagnosed by simple, non-invasive yet cost-effective measures like UCBLP.

Evidence based inclusion and exclusion criteria and conduction this study at esteemed institute like MGIMS Sevagram adds to its strength. Multidisciplinary approach and coordination between different departments (Obstetrics & Gynaecology, Paediatrics and Biochemistry) and there adherence to institutional Standard Operating Procedures (SOPs) provides validity to the findings of our study.

The major limitation of our study is its retrospective design as we have to totally rely on OPD/IPD case files and HIS, especially for prepregnancy weight and height. Another major limitation is small sample size. As per guidelines of Institute of Medicine and National Research Council, the recommended MWGDP is based on low, normal and high PPBMI and in order to effectively study the effect of MWGDP on UCBLP, studies with appropriate participant in all groups are required.

Conclusion:

The results suggest that low MWGDP has deleterious effect on UCBLP resulting in more atherogenic lipid levels. Confirmation of this association with the help of further studies might provide in development of better screening protocols especially for malnutrition prone countries like ours' aiming at prevention of future life cardiovascular risks.

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