ECRONICON OPEN ACCESS

EC PAEDIATRICS
Research Article

Maternal Anthropometry and Weight Gain as Risk Factors for Low Birth Weight in Singleton Uncomplicated Pregnancies

Rafia Bano*, Shahida Banu and S Bushra Fatima

Department of Clinical Nutrition, College of Applied Medical Sciences, University of Hail, KSA

***Corresponding Author:** Rafia Bano, Department of Clinical Nutrition, College of Applied Medical Sciences, University of Hail, KSA.

Received: November 24, 2016; **Published:** December 07, 2016

Abstract

Objectives: The present cross sectional study was done to investigate the maternal anthropometry and weight gain in relation to pregnancy outcomes of mothers in Hail city of Saudi Arabia.

Methods: The study was carried out in two maternity hospitals of Hail, Saudi Arabia. Sample size of 522 mothers who delivered single live baby without any congenital abnormality were selected to be included in the present study. Mother's and infant's anthropometric measurements were taken with standard techniques. Hemoglobin, blood sugar and blood pressure were recorded using electronic devices. Information regarding the demographic characteristics, health status of mothers, antenatal checkups and health related habits were accessed through structured questionnaire. Data was entered and analyzed through the Statistical Package for Social Sciences (SPSS) 17.0 Software. Odds Ratios, Means, Pearson's correlation, Analysis of Variance were done to find out the risk factors associated with poor pregnancy outcome.

Results: The mean birth weight of the infants was 3.16 kg ranging from 1.7 kg to 5.4 kg. Male babies tend to be heavier, whereas 100% of the very low birth weight deliveries were only females. Other factors like maternal Body mass Index before pregnancy, Weight gain in pregnancy, Maternal anemia, presence of chronic illnesses like diabetes, Hypertension and hypo/hyperthyroidism had effected the birth weight of newborn infants.

Conclusion: The present study provides some useful data to promote healthy pregnancy outcomes. Maternal factors like nutritional status, poor pregnancy weight gain and unhealthy obstetric history are found to be the major risk factors.

Keywords: *Anthropometry; Maternity; Hemoglobin; Pregnancy; Body Mass Index*

Introduction

"Birth weight" is the first weight of the fetus or infant obtained after birth and should be measured during the first hour after birth, before the significant postnatal loss of weight occurs [1]. Low birth weight (LBW), a preventable and a major public health problem common in developing countries has been defined by the World Health Organization (WHO) as weight at birth of less than 2500g (5 pounds 8 ounces) [2]. Worldwide 15.5 percent of all infants are born with LBW among 20 million infants, where 95.6 percent of them from the developing countries. In developing countries, the level of low birth weight is 16.5 percent more than double the level compared with developed countries which is 7 percent [3,4]. According to World Health Rankings by WHO data published in May 2014 Low Birth Weight Deaths in Saudi Arabia reached 1,496 or 1.86% of total deaths [5].

LBW is associated with multiple health related problems resulting in high rates of infant's mortality and morbidity in developing coun-

tries. LBW at birth may be due to either premature birth or preterm birth (before 37 weeks of gestation) or retarded fetal (intrauterine) growth attributed to poor uteroplacental perfusion or small for gestational age [6,7]. Thus, LBW and preterm birth are consider as the important indicators of child morbidity and mortality, as well as maternal health and nutrition prior to or during pregnancy [8].

Researchers have found many maternal and fetal factors as significantly associated with birth weight [9]. Among them the most common include nutrient intake, resistance to infections and other illness. Several studies suggest other factors like maternal age, increase in weight, stature, parity, close birth spacing, lifestyle, health related habits as responsible for LBW infants [10]. Poor nutrient intake will affect the growth of the fetus, the plasma volume, the maternal tissue supporting the fetus resulting in LBW [11]. Nutrient and oxygen supply, maternal infections transmitting through placenta, utero placental blood flow, the size of the uterus and the gestational period has a strong emphasis on the fetal growth [12]. Chronic diseases like maternal hypertension can affect the fetal growth due to reduction in blood flow or due to an increased risk of preeclampsia [13]. By overlooking these factors as a relevant public health issue and by the fact that limited community based studies are available, we carried out this study aiming to identify and investigate maternal risk factors associated with low birth weight.

Methods

Demography of the Study area: The present cross sectional study was conducted in the maternity wards of two hospitals - Hail General Hospital and Maternity and Children Hospital- in the centre of Hail city of Saudi Arabia. Hail is located in the northern region of the country. It has an area of 103,887 km^2 and a population of 527,033 (2004 census) consisting 49.9% women [14]. According to the data of the ministry of health, the birth rate is 18.78 births/1,000 population and the fertility rate is 2.17 children born/woman [15]. Also, the percentage of Low Birth Weight deliveries is estimated to be 8% [15].

Study population

For the purpose of getting permission, letters were given to the administrative and higher authorities of the hospitals from the Principal investigator and head of the department of clinical Nutrition, University of Hail. The study was initiated after getting an informed consent from the Hospitals as well as the patient. All those mothers who were willing to participate in the present study were interviewed.

The sample size was calculated on the basis of total prevalence rate of Low Birth Weight deliveries in previous studies. A total of 522 cases (irrespective of the mode of delivery) aged 18 to > 40 years, who delivered a single live baby through without any congenital malformation and completed gestational age of ≥ 37 weeks were enrolled for the present study. Data was obtained from hospital records within 1 day of delivery. Mothers who had twin births or triplets or gave birth to babies with congenital abnormalities were excluded.

Procedure

A pre-tested and modified questionnaire was used for the purpose of data collection, which was translated into Arabic for the ease of the mothers. Information was gathered from interviews with mothers of the new born babies, from the medical files and biochemical examination of the mothers. Hospital records were checked to identify cases.

Information regarding age, education of both parents and other socio demographic characteristics were asked from the mother and crosschecked from the medical records for validation. Other variables included parity, total number of abortions, number of Anti Natal Visits (ANC) during pregnancy, nutritional status of mother, amount of physical activity including household work and hours of rest and sleep. The socioeconomic status was assessed from the employment of mother, total family income and the type of family (joint/nuclear). The interval between present and previous delivery was also recorded. The total number of Anti Natal Checkups were recorded as 1, 2, 3, or ≤ 4 visits as according to WHO standards [16].

Maternal nutritional status was assessed with the help of pre-pregnancy weight and Body Mass Index (BMI), Hemoglobin level before and after delivery, Blood pressure, Blood sugar level and presence of any chronic illness (like CVD, Diabetes, asthma or thyroid problems).

Pre-pregnancy weight was asked from the mothers and crosschecked from the medical file of the patient. Height was measured up to the nearest centimeter.

Maternal hemoglobin was checked both before and after the delivery by portable electronic hemoglobinometer with disposable strips using spectrophotometric technique. Random blood sugar was measured using electronic glucometer (One touch, ultra- Lifescan Johnson & Johnson, Milpitas, USA). One single prick was done to draw blood for both measurements. Blood pressure was measured using electronic wrist blood pressure machine (Beurer medical - Germany). Medical records of the biochemical parameters were also checked and the average of all readings was considered for evaluation.

Information regarding the gestational age, parity, number of abortions were taken from the medical file. Weight gain during pregnancy was obtained by subtracting the final weight before delivery from the pre-pregnancy weight.

Use of iron and calcium tablets were considered as appropriate only if taken for ≥ 3 months during pregnancy. An account of the house hold works done, hours of mid-day rest and night sleep, and exercise frequency was taken with the help of questionnaire to judge the level of physical activity.

Anthropometry of the new born: Sex of the Infant, birth weight, height, head circumference and weight of placenta were measured soon after the delivery and recorded in the file of the mother and neonate.

Ethics: The present study has been approved by the research deanship, University of Hail, Hail, Saudi Arabia (AMS 13-4). Study was initiated only after getting informed consent from the hospital authorities.

Results: Total sample size was calculated to be 522. Descriptive statistics of the study population is represented in Table 1. Present study shows that the mean age of the mothers was 30.3 years (range 18 - 48 years). The mean birth weight of total deliveries was found to be 3.16 kilo grams (range 1.7 - 5.4 kg). The average BMI of the mothers before pregnancy was 26.86 ± 5.3 which means that the average mothers were overweight before conception.

Variables	N	Range	Minimum	Maximum	Mean	Std. Deviation
Weight of placenta	522	880	330	1210	636.07	± 138.85
Head circumference of the baby	522	15.0	30.0	45.0	34.79	± 1.86
Height of the baby	522	15	43	58	49.98	± 2.83
Birth weight of the baby	522	3.7	1.7	5.4	3.16	± 0.61
Age of the mother	522	30	18	48	30.28	± 6.31
Height of the mother	522	90	85	175	157.97	± 5.44
Weight of mother before pregnancy	522	120	36	156	67.40	± 14.29
BMI before pregnancy	522	25.8	16.0	41.8	26.86	± 5.26
Total weight gain in pregnancy	522	16	2	18	8.24	± 3.19

Table 1: *Descriptive Statistics of the study population.*

Figure 1 shows the distribution of birth weight (classified according to the WHO standards [3]) according to the sex of the baby. It is clear from the present data that the total number of very low birth weight deliveries (< 2 kg) were only females. Among the category of

Low Birth weight (2 kg - less than 2.5 kg) the higher percentage (78%) were female babies as compared to 22% males. Among the normal birth weight babies, a higher percentage (53%) were males as compared to 47% females. Lastly, the high birth weight babies (greater than 4 kg) were only males (100%). These findings clearly show that the male infants tend to be heavier and healthier.

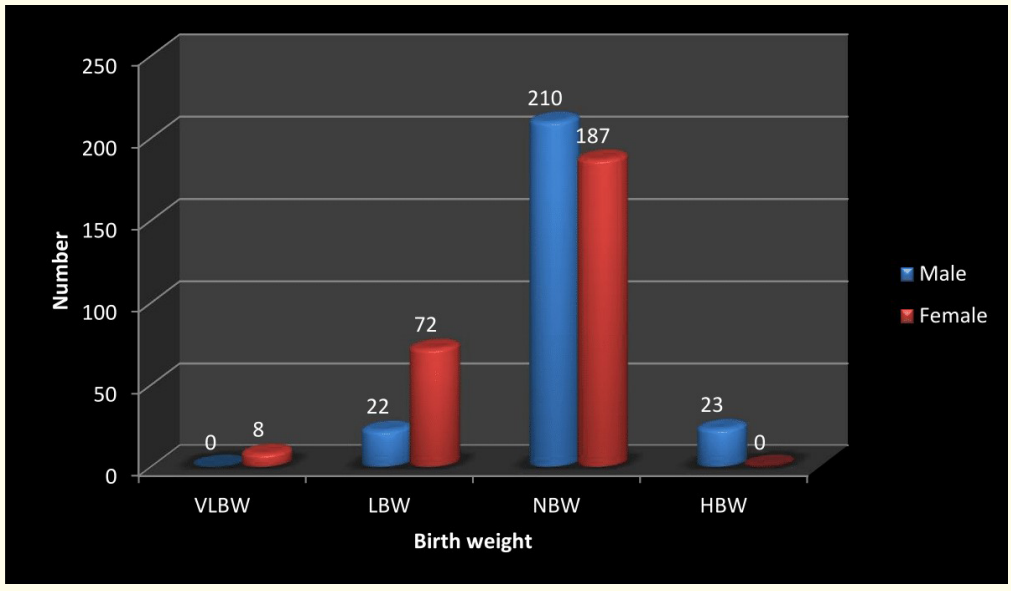

Figure 1: *Distribution of birth weight according to gender.*

Table 2 shows the correlation between Birth weight and total weight gain in pregnancy. According to chi square test and Pearson's correlation, the relation was found to be highly significant ($P < 0.001$).

Birth weight category	Total weight gain in pregnancy			Total
	< 5 kg	6 - 12 kg	> 12 kgs	
Low birth weight	67	35	0	102
Normal Birth weight	50	327	43	420
Total	117	362	43	522
	$\chi^2 = 138.7$ df 2, $P < 0.001$			

Table 2: *Birth weight in relation to Total weight gain in pregnancy.*

Analysis of variance (ANOVA) was performed to find out the correlation between pregnancy outcome and maternal parameters with total weight gain in pregnancy. The results are presented in table 3. It was observed that weight gain in pregnancy was significantly correlated with the important birth outcomes like birth weight, weight of placenta, and gestational age. On the other hand, maternal factors like age of mother and Pre-pregnancy BMI was also found to strongly correlated with Weight gain during pregnancy.

The present study demonstrated that the most significant factors responsible for low birth weight Spacing of ≤ 2 years, Maternal Height, pre-pregnancy weight and BMI, Thyroid disorders and < 4 visit to any health care centre during pregnancy (Table 4). However, the results from table 4 also indicate that mothers with hypertension had more prevalence of having a Low Birth weight baby (OR – 2.307; 95% CI 0.896 – 5.939). In our study Primigravida was not found to be significantly correlated to Birth weight.

Variables	Total weight gain in pregnancy				
	< 5 kgs (n = 117)	6 - 12 kgs (n = 362)	> 12 kgs (n = 43)	Total (n = 522)	ANOVA
Birth weight of the baby	2.8 ± 0.7	3.3 ± 0.5	3.4 ± 0.5	3.2 ± 0.6	P < 0.001**
Weight of placenta	555.7 ± 131.7	654.7 ± 130.7	697.9 ± 140.2	636.1 ± 138.8	P < 0.001**
Gestational age at birth	38.2 ± 1.7	38.6 ± 1.5	38.8 ± 1.5	38.5 ± 1.6	P < 0.05*
Age of the mother at the time of birth	31.5 ± 7.3	30.2 ± 5.9	27.8 ± 6.1	30.3 ± 6.3	P < 0.001**
BMI before pregnancy	28.3 ± 6.4	26.4 ± 4.9	26.8 ± 3.5	26.9 ± 5.3	P < 0.001**
Total weight gain in pregnancy	4.54 ± 0.8	8.7 ± 2.1	14.8 ± 2.3	8.2 ± 3.2	P < 0.001**

Table 3: *Analysis of Variance for Pregnancy outcome and maternal parameters with Total weight gain in pregnancy.*

Risk factors	n	% age	OR	95% CI	P value
Primigravida	119	22.8	1.283	0.781 – 2.110	0.324
History of Previous abortions	211	40.4	1.269	0.821 – 1.964	0.283
Spacing ≤ 2 yrs	286	54.7	3.109	1.905 – 5.076	0.000**
Height ≤ 152 cms	68	13.1	3.079	1.781 – 5.324	0.000**
Weight ≤ 52 kgs	105	20.1	5.661	3.507 – 9.136	0.000**
BMI ≤ 19 kg/m^2	34	6.5	8.117	3.905 – 16.871	0.000**
Hypertension	20	3.8	2.307	0.896 – 5.939	0.075
Diabetes	27	5.2	0.316	0.074 – 1.356	0.103
Thyroid disorders	19	3.6	7.867	3.013 – 20.538	0.000**
≤ 4 Antinatal Checkups	348	66.6	1.928	1.163 – 3.196	0.010*

Table 4: *Odds Ratio (95% CI) for the significant risk factors of low birth weight.*

Health related parameters	Low birth weight	Normal birth weight	OR	95% Confidential Interval	P value
Working status			1.76	0.940 – 3.304	0.07
Working	13	86	0.622	0.36 - 1.07	
House wife	89	334	1.097	1.004 – 1.199	
Exercise#			2.658	1.480 – 4.774	0.001**
< 3 days/week	87	288	1.244	1.22 – 1.379	
> 3days/week	15	132	0.468	0.287 – 0.782	
Mid-day rest			0.525	0.337 – 0.818	0.004**
Sufficient	57	297	0.790	0.658 – 0.949	
No rest	45	123	1.506	1.157 – 1.962	
Getting night sleep ≥ 6hrs			0.888	0.568 – 1.388	0.603
Yes	63	271	0.957	0.809 – 1.133	
No	39	149	1.075	0.816 – 1.424	

Physically active in house##			1.294	0.748 – 2.239	0.335
Yes	83	324	1.055	0.948 – 1.173	
No	19	96	0.815	0.524 – 1.268	

Table 5: *Risk estimate for health-related habits of mother according to birth weight.*

#Walking for at least 20 minutes/ day

##Doing house work without domestic help

Table 5 shows the estimate of risk through logistic regression for the health-related habits affecting birth weight. It was found that the amount of exercise (generally walking) done and the mid-day rest had significantly affected the birth weight.

Table 6 shows the correlation of pregnancy outcomes and the maternal anthropometric measurements as judged by the Odds ratio and Chi Square test. It was found that the Low Birth weight was significantly associated with short height (< 152 cms), Lower weight (< 52 kgs) and lower BMI (< 19 kg/m^2). Also the poor maternal nutritional status was found to be significantly correlated with weight of placenta at the time of birth. However poor maternal weight and BMI had affected the gestational age irrespective of height of the mother.

Pregnancy outcome	n	Prevalence %	Height (< 152 cms)	Pre-pregnancy Weight (< 52 kgs)	BMI (< 19kg/m^2)
Female baby	267	51.1	0.987 (0.637,1.53)	0.644* (0.452,0.919)	1.496 (0.772,2.891)
Low birth weight	102	19.5	2.54** (1.644,3.622)	3.46** (2.525,4.762)	6.652** (3.448,12.831)
Anemia	183	35	0.928 (0.587,1.469)	0.810 (0.573,1.145)	0.684 (0.356,1.313)
Placenta weight ≤ 500 gms	135	25.8	2.867** (1.859,4.421)	2.068** (1.480,2.889)	2.007* (1.040,4.3320
Gestational age ≤ 37 weeks	147	28.1	1.391 (0.879,2.203)	1.701** (1.210,2.391)	6.122** (3.002,12.487)

Table 6: *Odds Ratio and Risk Estimate (95% Confidential interval) for maternal anthropometry and pregnancy outcome.*

**P < 0.05*

***P < 0.01*

Discussion

The present study shows mean birth weight of infants as 3.16 kg falling in the normal range. When considering the preconception weight of the mothers, it was found that majority of the women were overweight (with BMI > 26) which has shown to have a lesser impact on the birth weight of the infant as the mean weight of the infant falls in the normal weight category. This is comparable to other studies concluding that overweight and obese women are at higher risk of giving birth to a preterm baby and a lower risk to deliver a LBW infant when compared to women with normal weight [17,18].

The present study clearly shows that female babies had a significantly higher incidence of low birth weight than male babies. Also, higher percentage of normal birth weight and high birth weight were noticed in their male counterparts. The findings were in agreement with other studies of LBW in relation to gender of the baby [19,20], concluding that female babies were significantly more prone to low

birth weight. Contrary to the present findings some researchers found that male babies are generally more vulnerable to LBW resulting in multiple infections [21].

Strong relationship was found between the total weight gain during pregnancy and Birth weight. The risk of having Low Birth Weight was more than two folds for the women whose total weight gain is less than 5 kg compared to total weight gain 6 - 12 kg. The results were found to be similar to another study conducted in Northern Ethiopia [22]. Present study also demonstrated that the maternal weight less than 52 kg have more risk of having LBW infants as compared to mothers with weight more than 52 kg. This is in line with the studies conducted by various researchers in India and Pakistan [23]. These findings could be attributed to the fact that the weight gain less than 5 kg might be related to poor nutrient intake during young age which continues during pregnancy affecting the fetal growth. In our study the poor nutritional status of the mother and weight of the placenta less than 500 g was significantly correlated with LBW.

Our results showed that the risk of LBW increases with maternal age, spacing, maternal height, weight gain during pregnancy, pre-pregnancy BMI. This was consistent with results from a number of other studies [17,24,25]. When considering the maternal age, early marriage and early childbearing, along with repeated pregnancies and short birth spacing increases the risk of having a LBW infant. Similar results are observed in the research conducted by S A Rizvi., *et al.* [26].

When considering the maternal height, values less than 152 cms were more prone to have LBW infants and our results are in accordance with the findings of other studies [27,28], which stated that short stature of mothers have higher risk of LBW. Short stature of mothers is associated with a narrow pelvis, which increases the likelihood of cephalopelvic disproportion and obstructed labor with insufficient supply of nutrients to the fetus. These finding are in line with the literature results concerning the harmful consequences of short statured mothers on fetus and infants in Northern Brazil [29].

Results of the present study show that the risk of LBW increased to some extent with anemia. On contrary a strong relation was found between anemia and LBW with the studies done on anemic pregnant women [30,31]. In the present study prevalence of low birth weight was found to be significantly correlated to the number of antenatal visits. This is in agreement with the findings of other researchers [32] which states about 21.3% were LBW infants with minimum number of antenatal visits. In the present study presence of thyroid disorders was highly significant for LBW infants. This is in consistent with the findings of Millar., *et al*. study [33] which proves that lack of control of hyperthyroidism significantly increases the risk of low birth weight infants and severe preeclampsia.

According to an online report in the Journal of Clinical Endocrinology & Metabolism states that exercise during pregnancy reduces the birth weight of offspring. In agreement with this statement, present study shows a statistically significant correlation with exercise and LBW prevalence. According to Hopkins., *et al*. [34] regular exercise was associated with lower birth weights and has an effect on decreased endocrine stimulation of fetal growth. In addition, inactive women had slightly lower risk of LBW infants. The other factors in our study such as hypertension, diabetes, physical activities and sleep did not attain statistical significance in the analysis. However, the clinical significance cannot be ruled out based on the findings of the present study.

Conclusion

Low birth weight is a condition from the health and nutritional status of the mother resulting in a health status of the infant determining its survival, healthy growth and development in adult life. The present study revealed that the proportion of low birth weight was around 20% in Hail, Saudi Arabia. The present study clearly shows that female babies had a significantly higher incidence of low birth weight than male babies. Also, higher percentage of normal birth weight and high birth weight were noticed in their male counterparts. Present study results showed that the risk of LBW increases with maternal age, spacing, maternal height, weight gain during pregnancy, pre-pregnancy BMI. Among all the risk factors discussed, low weight gain during pregnancy, short stature of the mother, exercise and antenatal care were the important predictors of low birth weight. To overcome these problems, special training and attention should be

encouraged in order to strengthen the mother and child health condition not only in health care services but also all in social development and welfare sectors of the community.

Acknowledgements

The authors are thankful to all the staff members of Clinical nutrition department for their help and cooperation and the Research Deanship, University of Hail, Saudi Arabia for providing the financial support for this study.

Authorship Statements

Conception and design of the study: Dr. Rafia Bano
Collection, Analysis and Interpretation of data: Dr. Rafia Bano, Shahida Banu and Syeda Busha Fatima
Drafting the article and revising: Dr. Rafia Bano, Ms. Shahida Banu
Final approval of the manuscript: Dr. Rafia Bano, Shahida Banu and Syeda Busha Fatima

Bibliography

1. Tessa wardlaw., *et al*. "A report on Low Birth Weight; Country, Regional and Global Estimates". *UNICEF and WHO* (2004).
2. "World Health Organization. Country, regional and global estimates. Geneva: World Health Organization (1992) International Statistical classification of diseases and related health problems". *WHO* (2005).
3. "United Nations Children's Fund and WHO: Low Birth Weight country, regional and global estimates". New York (2004).
4. Meresa Gebremedhin., *et al*. "Maternal associated factors of low birth weight: a hospital based cross-sectional mixed study in Tigray, Northern Ethiopia". *BMC Pregnancy Childbirth* 15 (2015): 222.
5. "Report on Low Birth weight in Saudi Arabia". *World life expectancy rates* (2014).
6. "World Health Organization. International statistical classification of diseases and related health problems. 10th revision, version for 2007". *Geneva: WHO* (2007).
7. Goldenberg RL and Culhane JF. "Low birth weight in the United States". *American Journal of Clinical Nutrition* 85.2 (2007): 584S-590S.
8. "World Health Organization. The world health report. Make every mother and child count. The greatest risks to life are in its beginning". *Geneva: WHO* (2005): 79-81
9. Singh G., *et al*. "Maternal factors for low birth weight babies". *Medical Journal Armed Forces India* 65.1 (2009): 10-12.
10. Megabiaw BM., *et al*. "Incidence and correlates of low birth weight at a referral hospital in Northwest Ethiopia". *Pan African Medical Journal* 12 (2012): 4.
11. Carmichael SL and Abrams B. "A critical review of the relationship between gestational weight gain and preterm delivery". *Obstetrics and Gynecology* 89 (1997): 865-873.
12. Kliegman RM and Das UG. "Intrauterine growth retardation". In: Fanaroff AA, Martin RJ, eds. Neonatal Perinatal Medicine: Diseases of the fetus and infants, Mosby (2001): 228-262.
13. Halterman EG., *et al*. "Effect of uncomplicated chronic hypertension on risk of SGA birth". *American Journal of Epidemiology* 145.8 (1997): 689-695.
14. Demography of hail region (2015).
15. Health indicators given by the ministry of health, Saudi Arabia (2015).

16. "Prevention and care of illness. Neonates and infants. 12 key family practices". *Geneva, World Health Organization* 2004 (2015).

17. Sachin S., *et al*. "Maternal Risk Factors Associated with Term Low Birth Weight Neonates: A Matched-Pair Case Control Study". *Indian Pediatric* 49.1 (2012): 25-28.

18. Sarah D McDonald., *et al*. "Overweight and obesity in mothers and risk of preterm birth and low birth weight infants: systematic review and meta-analyses". *British Medical Journal* 341 (2010): c3428.

19. Mondal B. "Low birth weight in relation to sex of baby, maternal age and parity: a hospital based study on Tangsa tribe from Arunachal Pradesh". *Journal of the Indian Medical Association* 96.12 (1998): 362-364.

20. I Abdelmoneim. "A study of determinants of low birth weight in Abha, Saudi Arabia". *African Journal of Medicine and Medical Sciences* 33.2 (2004): 145-148.

21. D K Stevenson., *et al*. "Sex differences in outcomes of very low birthweight infants: the newborn male disadvantage". *Archives of Disease in Childhood - Fetal and Neonatal Edition* 83.3 (2000): F182-F185.

22. Meresa Gebremedhin., *et al.* "Maternal associated factors of low birth weight: a hospital based cross-sectional mixed study in Tigray, Northern Ethiopia". BMC Pregnancy and Childbirth 15 (2015): 222

23. Mumbare SS., *et al.* "Maternal risk factors associated with term low birth weight neonates". *Indian Pediatrics* 49.1 (2012): 25-28.

24. Dickute J., *et al*. "Do maternal social factors, health behavior and work conditions during pregnancy increases the risk of low birth weight in Lithuania". *Medicina* 38.3 (2002): 321-332.

25. Rich-Edwards JW., *et al*. "Diverging associations of maternal age with LBW for black and white mothers". *International journal of Epidemiology* 32.1 (2003): 83-90.

26. S A Rizvi., *et al*. "Maternal risk factors associated with low birth weight in Karachi: a case control study". *Eastern Mediterranean Health Journal* 13.6 (2007): 1343-1352.

27. J S Deshmukh., *et al*. "Low Birth Weight and Associated Maternal Factors in An Urban Area". *Indian Pediatrics* 35.1 (1998): 33-36.

28. Ghosh S., *et al*. "Biosocial determinants of birth weight". *Indian Pediatric* 14.2 (1977): 107-113.

29. Ozaltin E., *et al*. "Association of maternal stature with offspring mortality, underweight, and stunting in low- to middle-income countries". *Journal of the American Medical Association* 303.15 (2010): 1507- 1516.

30. Revilane Parente de Alencar Britto., *et al.* "Influence of Maternal Height and Weight on Low Birth Weight: A Cross-Sectional Study in Poor Communities of Northeastern Brazil". *PLoS One* 8.11 (2013): e80159.

31. Wannous S and Arous S. "Incidence and determinants of low birth weight in Syrian government hospitals". *Eastern Mediterranean Health Journal* 7.6 (2001): 966-974.

32. Mohammed A Abdal Qader., *et al*. "Influence of antenatal care on birth weight: a cross sectional study in Baghdad City, Iraq". *BMC Public Health* 12.2 (2012): A38.

33. Millar Lynnae K., *et al*. "Low Birth Weight and Preeclampsia in Pregnancies Complicated by Hyperthyroidism". *Obstetrics and Gynecology* 84.6 (1994): 946-949.

34. Hopkins SA., *et al.* "Exercise training in pregnancy reduces offspring size without changes in maternal insulin sensitivity". *Journal of Clinical Endocrinology and Metabolism* 95.5 (2010): 2080-2088.

Volume 3 Issue 2 December 2016