INCIDENCE AND POTENTIAL RISK FACTORS OF LOW BIRTH WEIGHT AMONG FULL TERM DELIVERIES

Ammar M Alfadhli,[2] Ali M Hajia,[2] Farida AK Mohammed,[3] Hamdiya A Alfadhli,[4] Medhat K El-Shazly[5]

[1]MRCGP-INT. Head of Al-Waha Clinic, Al-Jahra Health Area, Primary Health Care, Ministry of Health, Kuwait. [2]MRCGP-Kuw. Head of Al-Riqqa Clinic, Al-Ahmadi Health Area, Primary Health Care, Ministry of Health, Kuwait.[3]MRCGP-Kuw. Al-Rumaithiya Specialized Clinic, Hawali Health Area, Primary Health Care, Ministry of Health, Kuwait. [4]MRCGP-Kuw. Head of Al-Dahar Clinic, Al-Ahmadi Health Area, Primary Health Care, Ministry of Health, Kuwait. [1]MD, Department of Medical Statistics, Medical Research Institute, Alexandria University, Egypt. & Department of Health Information and Medical record, Ministry of Health, Kuwait

Receive: 17 / 4 /2010 - Accepted: 21 / 5 / 2010.

ABSTRACT

Background: *Low birth weight (less than 2500 grams) (LBW) is a reliable indicator in monitoring and evaluating the success of maternal and child health programs. Giving birth to a LBW infant is influenced by several factors.*
Objective: *The aim of the study was to determine the incidence of LBW among live born full term deliveries in Al-Adan governmental hospital and to study the possible determinants of its occurrence.*
Methods: *The first phase of the study was a descriptive one including all live born full term deliveries of women attended the hospital within the first 2 months of pregnancy and followed up till delivery. In the second phase LBW women (cases) were compared with a double number of women who gave birth to normal birth weight infants.*
Results: *Among 939 women eligible for the study, the incidence of LBW was 7.8%. Reproductive age lower than 25 years, gestational age lower than 40 weeks, history of previous abortion, primiparity, maternal underweight and anemia were detected as independent risk factors for LBW. On the other hand, obesity was a protective factor.*
Conclusion: *Low birth weight occurs frequently in Kuwait, although its incidence is much lower than in many countries in the region. Prenatal management of modifiable factors and adequate antenatal care and screening for susceptible women should be a target for all obstetricians for reducing the incidence of LBW*
Key words: *Low birth weight- incidence- associated factors.*

INTRODUCTION

Low birth weight (LBW) is the weight at birth of less than 2500 grams irrespective of the gestational age. It is a reliable indicator in monitoring and evaluating the success of maternal and child health programs.[1] Across the world, neonatal mortality is 20 times more likely for low LBW babies compared to heavier babies. Such LBW babies remain a burden on government expense in developed countries and a permanent problem for their families in developing countries.[2-5]

At the population level, the proportion of babies with a LBW is an indicator of a multifaceted public-health problem that includes long-term maternal malnutrition, ill health, hard work and poor health care in pregnancy. On an individual basis, LBW is an important predictor of newborn health and survival.[6] The evidence suggests that LBW, as a poor birth outcome, affects the person throughout life course and is associated with a higher risk of developmental impairments including cognitive development, medical and health outcomes in adulthood.[7]

On average, the incidence of LBW is estimated to be 16% worldwide, 19% in the least developed and developing countries and 7% in the developed countries like Sweden, France, United States and Canada.[2,6,8] The incidence of LBW varies among countries, ranging from 4% to 6% in Western countries and much higher in developing countries. It is estimated worldwide that more than 95% of LBW infants are born in developing countries. Seventy two percent of LBW infants are born in Asia, although large differences exist in WHO Asian regions and its sub-regions. It is estimated that there are 8% of LBW infants in Eastern Mediterranean region.[9] The incidence of LBW is 31% in South Asia followed by Middle East and North Africa (15%), Sub-Saharan Africa (14%) and East Asia and Pacific 7%.[8] The reduction in the incidence of LBW by one-third between 2000 and 2010 with the objective of reducing child mortality is one of the Millennium development Goals established by the World Health Organization and proposed in 2005 in their "Declaration and Recommendations for Action".[1]

Giving birth to a LBW infant is influenced by several determinants including maternal variables, socioeconomic status and environmental factors.[10,11] The biological processes that affect the in-utero fetus are related to the mother's physiology, including her nutrition, exercise, infections, and consumption of tobacco, alcohol and other drugs.[12]

Correspondence to: Prof. Medhat Shazly, Department of Medical Statistics, Medical, Research Institute, Alexandria University, Tel: 00965/66612524, E-mail: medhat_shazly@hotmail.com

pISSN: 1110-0834
eISSN: 2090-2948

For many women in the developing world, however, economic, social and cultural factors make it difficult for them to obtain the necessary food and healthcare, which are closely interrelated.[11-13] Placental structure and function determine the growth trajectory of the fetus. Several studies show that abnormal placental growth is associated with adverse pregnancy outcomes.[13]

Birth weight data are needed for monitoring and evaluating progress towards achieving national strategies for lowering LBW rates, as well as global child survival goals of reducing infant and under five child mortality. This study investigated the magnitude of LBW in Kuwait and the contribution of potential risk factors with LBW in all singleton births in Adan hospital in Kuwait.

METHODS

Setting and design:

The present study was conducted during the period from January to December 2006 inclusively in Al-Adan hospital which is one of 6 general governmental hospitals in Kuwait. In 2006, 6899 live birth deliveries were registered in that hospital out of total 54571 live births in Kuwait.

The study design can be differentiated into two phases. The first phase was a prospective descriptive one to determine the incidence of LBW among full term singleton women. All singleton Kuwaiti or non-Kuwaiti women booked in the first two months for antenatal care at Al-Adan hospital, during the study period, were potentially recruited and followed through their pregnancies until delivery.

Inclusion criteria included Kuwaiti and non-Kuwaiti women, giving birth to live born singleton infants without any apparent congenital anomalies, gestational age from 36 to 42 weeks, and completing the study to an end point of delivery. Pregnant women were usually enrolled at their first prenatal visit.

Participants were deemed ineligible if they were incarcerated, were planning to move from the area, or gave birth on the day they were recruited into the study. Also exclusion criteria included women with sever chronic diseases, those with twin or multiple pregnancies, or gave birth to less than 500 grams or mare than 4000 grams newborn.

Recruitment efforts resulted in 1125 contacts from potential participants. Only 912 pregnant women were enrolled because they fulfilled the inclusion criteria. Of them, 73 gave birth to LBW newborn infants.

The second phase was a case-control study to investigate factors that could be associated with LBW, whereas all women with LBW (case group, n =73) were compared with a double number of women gave birth to normal weight infants, chosen randomly from the recruited women (control group, n=146).

Informed written consent was taken from all recruited women for the purpose of the study.

Data Collection

Study visits were scheduled, once early in pregnancy (first trimester), during second trimester, during the third trimester, and a fourth one at delivery. Trained obstetricians in the chosen hospital collected data by interviewing participants. In order to ensure uniformity of data measuring methods that relied on clinical judgment, they were trained on data collection and the questionnaire was thoroughly tested for clarity before it was accepted. Physical examination, laboratory investigations, as well as participants' record study were conducted by the trained doctors during each visit.

Study questionnaires

The structured interview method has been adopted to collect data for this study with a specially designed questionnaire. It was derived from other published studies dealing with the same topic as well as from our own experience. It included personal characteristics (age, nationality, education, occupation, weight, height and BMI at the beginning of pregnancy) and reproductive and clinical data (gravidity, parity, history of previous abortion, antenatal care, hypertension and anemia) in addition to the new born measurements (gestational age, gender, weight, height, and head circumference).

Measurements:

Parity was obtained by self-report during the personal interview. Maternal age was based on age at entry into the study. Anemia was defined as having hemoglobin < 10.0 g/ dL or at any time point during the pregnancy. Mothers were classified as having gestational diabetes if they were diagnosed with diabetes, initiated insulin, or received an abnormal glucose tolerance test result during the pregnancy. Hypertensive disease was defined as having a systolic blood pressure ≥ 160 mmHg or/and a diastolic blood pressure ≥ 90 mmHg and thus the study included women with chronic hypertension, pregnancy-induced hypertension and preeclampsia.

Maternal weight and height were measured upon enrollment in the study and mother's weight prior to pregnancy was based on self report. Maternal pre-pregnancy body mass index (BMI) was calculated as pre-pregnancy weight in kilograms divided by measured height in meters squared. Body mass index was used as a measure of obesity whereas normal range was between 20 and less than 25. Individuals with a BMI < 20 were categorized as underweight. Individuals with a BMI between 25 and 29.9 were considered as overweight, while individuals with a BMI of more than 30 were considered obese. At delivery, just prior to giving birth, mother's weight was measured to determine weight gain during pregnancy.

Statistical Analysis

Simple descriptive statistics were used (mean

± standard deviation for quantitative variables, and frequency with percentage distribution for categorized variables). Analysis was initially carried out based on a series of bivariate comparisons. In order to control simultaneously for possible confounding effect of the variables, multiple logistic regression analysis was used

In the bivariate analysis Chi-square and Fisher exact tests were used where appropriate to detect the association between LBW and explanatory variables. In multiple logistic regression analysis, the association between exposure and outcome was expressed in terms of odds ratio (OR) together with their 95% confidence intervals (95% CI).

All the explanatory variables included in the logistic model were categorized into two or more levels (R = reference category): age (years): < 25[R], ≥ 25; nationality: Kuwaiti[R], non-Kuwaiti; occupation[R]: working, not working; education: less than secondary[R], secondary or higher; gravidity: < 4[R], ≥ 4; parity: 0[R], 1-3, ≥ 4; previous abortion: no [R], yes; BMI: normal [R], under weight, overweight, obese; weight gain during pregnancy (Kg): < 12 [R], ≥ 12; antenatal visits: non [R], < 4, ≥ 4; gestational age at delivery (week): < 40 [R], ≥ 40; newborn gender: male [R], female; essential hypertension: no [R], yes; gestational hypertension: no [R], yes; pre-eclampcia: no [R], yes; antepartum hemorrhage: no [R], yes; anemia in first, second and third trimester: no [R], yes. Analysis was performed using SPSS package

RESULTS

Out of 939 women participated in the study 73 gave birth to LBW infants with an overall 7.8% incidence rate. Their characteristics were presented in table I. The mean gestational age at delivery was 38.8 ± 2.5 weeks. Their mean birth weight was 2145 ± 305 grams, height 46.0 + 3.2 centimeters, head circumference 32.4 ± 1.9, and placental weight 516 ± 96 grams.

A total of 73 cases with LBW newborn were compared with 146 women with normal birth weight infants. The personal, clinical, conceptional and obstetric characteristics with the results of bivariate analyses were presented in tables II and III. The results of the final analysis using multiple logistic regression were summarized in table IV.

Results of multiple logistic regression analyses

No significant association between LBW and personal factors of women was detected except for age. Older women (≥ 25 years) were less liable to give birth to LBW as compared to those < 25 years old (OR = 0.2, 95% CI: 0.1 – 0.4). Among clinical factors, conceptional and obstetric factors, higher gestational age at delivery and mutiparity were protective against LBW (OR = 0.2, 95% CI: 0.1 – 0.4). Women with previous history of abortion were at higher risk of giving birth to LBW (OR = 1.2, 95% CI: 1.1 – 1.6) Anemia in the first trimester was significantly associated with LBW (OR = 6.3, 95% CI: 3.1 – 12.9). Extremes of BMI were also significantly associated with LBW, whereas underweight was a risk factor and obesity was a protective one (OR = 2.2, 95% CI: 1.1 – 4.2) and (OR = 0.8, 95% CI: 0.7 – 0.9) respectively. Gaining weight ≥ 12 kilograms during pregnancy was proved to be protective against LBW (OR = 0.7, 95% CI: 0.6 – 0.9)

Table I: Characteristics of low birth weight newborns

Variable	Mean ± Standard deviation
Gestational age at delivery (weeks)	38.8 ± 2.5
Birth weight (grams)	2145 ± 304.9
Birth height (grams)	46.0 ± 3.2
Head circumference (cm)	32.4 ± 1.9
Placental weight (grams)	515.8 ± 95.5

Table II: socio-demographic characteristics of cases and controls

Variables	Birth weight				Significance
	Normal (n=146)		Low (n=73)		
	No.	%	No.	%	
Age (years):					
< 25 y	43	29.5	32	43.8	$X^2 = 5.695$
≥ 25	103	70.5	41	56.2	P = 0.03
Nationality:					
Kuwaiti	87	59.6	44	60.3	$X^2 = 0.01$
Non-Kuwaiti	59	40.4	29	39.7	P = 0.92
Occupation:					
Working	39	26.7	21	28.8	$X^2 = 0.10$
Not working	107	73.3	52	71.2	P =0.75
Education:					
< secondary	59	40.4	39	53.4	$X^2 = 3.33$
Secondary or higher	87	59.6	34	56.6	P = 0.07

Table III: Clinical, conceptional and obstetric characteristics of cases and control

Variables	Birth weight					Significance
	Normal (n=146)			Low (n=73)		
	No.	%		No.	%	
Gravidity:						
< 4	92	63.0		52	71.2	$X^2 = 1.46$
≥ 4	54	37.0		21	28.8	P = 0.23
Parity:						
0	22	15.1		27	37.0	$X^2 = 13.65$
1-3	90	61.6		35	47.9	P = 0.001
≥ 4	34	23.3		11	15.1	
Previous abortion:						
No	116	80.2		49	67.1	$X^2 = 4.80$
Yes	28	19.2		24	32.9	P = 0.03
BMI at beginning of pregnancy:						
Normal	64	11.0	43.8	32	43.8	$X^2 = 8.14$
Under weight	16	43.8	11.0	18	24.7	P = 0.04
Over weight	51	37.0	34.9	18	24.7	
Obese	15	8.2	10.3	5	6.8	
Weight gain during pregnancy:						
< 12 Kg	90	61.6		56	76.7	$X^2 = 4.97$
≥ 12 Kg	56	38.4		17	23.3	P = 0.03
Antenatal visits:						
No	15	10.3		13	17.8	$X^2 = 2.48$
< 4	88	60.3		40	54.8	P = 0.30
≥4	43	29.5		20	27.4	
Gestational age at delivery:						
< 40	73	50.0		60	82.2	$X^2 = 21.15$
≥40	73	50.0		13	17.8	P < 0.001
Newborn gender:						
Male	78	53.4		38	52.1	$X^2 = 0.04$
Female	68	46.6		35	47.9	P = 0.84
Essential hypertension:						
No	145	99.3		66	90.4	P= 0.001$^{\$}$
Yes	1	0.7		7	9.6	
Pregnancy induced hypertension:						
No	143	97.9		64	87.7	P = 0.003$^{\$}$
Yes	3	2.1		9	12.3	
Pre-eclampcia:						
No	145	99.3		65	89.0	P = 0.001$^{\$}$
Yes	1	0.7		8	11.0	
Antepartum hemorrhage:						
No	146	100.0		67	91.8	P = 0.001$^{\$}$
Yes	0	0.0		6	8.2	
Anemia in the first trimester:						
No	110	75.3		31	42.5	$X^2 = 22.93$
Yes	36	24.7		42	57.5	P < 0.001
Anemia in the second trimester:						
No	112	76.7		36	49.3	$X^2 = 16.67$
Yes	34	23.3		37	50.7	P < 0.001
Anemia in the third trimester:						
No	123	84.2		53	72.6	$X^2 = 4.18$
Yes	23	15.8		20	27.4	P = 0.04

Table IV: Factors associated with low birth weight, results of multivariate logistic regression analysis

Variable	Exp(B)	95% CI
Maternal age (years):		
<40(R)	1	
≥40	0.2	0.1 – 0.4
Gestational age at delivery (weeks):		
<40(R)	1	
≥40	0.2	0.1 – 0.4
Parity;		
0(R)	1	
<4	0.2	0.1 – 0.5
≥4	0.2	0.1 – 0.6
Previous abortion;		
No(R)	1	
Yes	1.2	1.1 – 1.6
Anemia in first trimester:		
No(R)	1	
Yes	6.3	3.1 – 12.9
BMI at the beginning of pregnancy:		
Normal(R)	1	
Under weight	2.2	1.1 – 4.2
Over weight	0.9	0.7 – 1.2
Obese	0.8	0.7 – 0.9
Weight gain during pregnancy:		
< 12 Kg(R)	1	
≥ 12 Kg	0.7	0.6 – 0.9

DISCUSSION

According to the WHO statistics, the rate of LBW worldwide is 17% (6% in industrialized countries and 21% in developing countries). In consistent with a previous study by El-Shazly et al that was conducted during 2004 in Kuwait,[14] the incidence of LBW in our study was 7.8%. This rate is higher than those reported in countries with minor LBW rates like European countries (6.5%) or USA (6.8%).[15] However, the incidence of LBW in Kuwait is still far below the reported world average of 16.0% in general. Also, it is lower than the average incidence for Asian countries (19.7%) that ranged from very low as in China (6.7%) to very high as in India (30.0%)[16,17] This low figure reported in Kuwait was mainly attributed to the availability and accessibility of antenatal health care facilities developed in Kuwait.

In the Eastern Mediterranean Region, the incidence of LBW in the Islamic Republic of Iran was 10% as published in 2007,[11] 12.8% as published in 2009,[18] and 6.8% in a more recent study published in 2010.[19] In Saudi Arabia, Al Eissa et al,[20] in their multicentre prospective study in Riyadh, reported an incidence of LBW of 7.4% among live born infants. However, another study found an incidence of 13.6% LBW in a cohort of infants studied in Al-Taif. [21] These wide variations may be due to the study design, setting, and population sample, and inclusion of exclusion of preterm deliveries.

In the present study various factors associated with LBW were identified. Reproductive age lower than 25 years, gestational age lower than 40 weeks, history of previous abortion, primiparity, maternal underweight and anemia were detected as independent risk factors for LBW. On the other hand, obesity was proved to be a protective factor. These results are in agreement with that published in the literatures for many factors.[18,22,23]

Findings from international studies have shown an association between lower maternal age and giving birth to a LBW infant.[10,24] Our results revealed that LBW mothers were significantly had lower mean age than mothers of normal birth weight, and that women less than 25 years old had greater risk of LBW. In agreement, Kuo[25] found in his study higher incidence of LBW among adolescent than in adult women. This could be due to under development of female genital organs particularly the uterus. Older women may not be at increased risk because of their age alone, but their age may augment the impact of other risk factors. However, Coutinho et al,[18] found that extremes of age (less than 20 and over thirty years old) were both positively associated with LBW.

In this study, gestational age was significantly associated with neonatal birth weight. Actually the mean birth weight has been described as a function of gestational age. It is recommended to suppress

labor in women carrying small healthy fetuses, supposing that no immediate fetal or maternal indications mitigate towards the timely delivery of undersized fetus.[21]

It is known that gravity and parity are associated with birth weight but it is unclear whether these associations are causal or they reflect differential pregnancy planning.[26] Studies on the topic have shown that primiparous women have a greater risk of LBW than multiparous women.[27,28] The results of the present study revealed that gravity has no association with LBW but multiparity was a protective factor against LBW. This is consistent with other studies reported that primiparae have a worse pregnancy outcome than multiparae do. However, these results should be interpreted cautiously because the difference could be related to their age, height, pre-pregnancy weight, gestational nutrition and use of antenatal care, in addition to the presence of some obstetric morbidity among them.[27,28] Coutinho et al, found that parity was associated with LBW in bivariate analysis but not in multiple logistic analysis that might explain the confounding effect of other factors.[18]

Previous spontaneous abortion and is known as a determinant of LBW,[29,30] w hich was also seen in our study whereas mothers with previous history of abortion were at 20% higher risk to deliver LBW babies compared to those without. Women with a history of abortion have a greater chance of having infant with LBW, and that the risk increased as the number of abortions increased. A possible explanation for this may be the association between abortions and morbidities that affect placental vasculature that is also associated with LBW.[18] Infection, mechanical trauma to the cervix leading to cervical incompetence and scarred tissue following curettage are suspected mechanisms.[29]

Documented research has confirmed that maternal diseases increase the risk of delivering LBW infants These morbidities may be associated with impaired fetal growth.[28] In agreement with that, the present study revealed that hypertension and anaemia at any stage of pregnancy were encountered in a significantly higher proportions among LBW mothers. However, after logistic analysis only anemia in the first trimester remained as an independent predictor of LBW whereas women suffered from anemia in the first trimester were at more than 6 times higher risk to deliver LBW infants than those without anemia. Low hemoglobin level could lead to decreased oxygen support to the fetus and might be a marker of some other risk factors such as poor nutrition or infection that may could independently cause LBW.[14] In Kuwait it is mostly due to imbalance of food constituents, rather than under-nutrition, leading to deficiency of certain dietary elements. Special emphasis should be given to anemic women during antenatal care. Also routine supplement may be warranted.

In the present study, extremes of BMI were significantly associated with LBW. Under weight was found to be a risk factor as proved by many previous studies. On the other hand, obesity was proved to be a protective factor. This could be due to the fact that obese women have a greater risk of developing hyperglycemic state that is commonly associated with a greater gain in fetal weight.[18]

Results of the present study revealed that weight gain of 12 kilograms at least during pregnancy was a protective factor against LBW. Borkowski W, in his study found that pre-pregnancy low BMI together with small pregnancy weight gain rate is an important risk factor for LBW.[31] Also, Lawoyin TO found that mothers who delivered LBW babies gained significantly less weight in the 3rd trimester and last 4 weeks of term pregnancy when compared with controls who had normal weight babies.[32] Pregnant women must eat well and encouraged to eat a variety of foods depending on body type and weight before conception. Weight gain is a normal and healthy part of pregnancy and physicians should recommend general guidelines for healthy eating. The pregnant woman's diet should include the basic nutrients necessary to meet the demands of the developing fetus to have a healthy birth weight. Most women who deliver healthy babies gain about 12 kilograms more during pregnancy. Women who are underweight prior to pregnancy should gain a little more, and overweight women, a little less.[25,31,32]

Finally, it was found in the present study that the number of antenatal visits correlated negatively with fetal weight at birth in the bivariate analysis but not after adjustment for confounding. It is also possible that those who did not attend antenatal care at all comprise the group at lower risk of pregnancy complications. The findings indicate that, while more effort is needed to stimulate public awareness of antenatal care, the approach to antenatal care needs re-evaluation, with more emphasis on simple and reliable means of identifying at-risk groups

We acknowledge some limitations in our study. As we relied upon patient interview and record study, the data obtained might be, to certain extent, affected by the quality of recording. Also, as in any case control study, the design of the study is by definition retrospective and is subjected to recall bias. There is a limitation with accuracy of the duration of pregnancy and pre-pregnancy weight as they were based on self reports from pregnant women. Nevertheless, the results are consistent with those coming from cohort studies. Also, other potential factors that could affect birth weight as smoking, consanguinity of parents, maternal nutrition during pregnancy were not included.

Conclusion

Low birth weight occurs frequently in Kuwait, although its incidence is much lower than in many countries in the region. Young, under weight, anemic, primiparous women who give birth before 40 weeks of gestational age are at risk of giving birth to LBW. Prenatal management of modifiable factors and adequate antenatal care and screening for susceptible women should be a target for all obstetricians for reducing the incidence of LBW

REFERENCES

1. World Health Organization. Country, region and global estimates. Geneva: WHO 2005.
2. United Nations Children's Fund and World Health Organization, Low birth: Country, regional and global estimates. UNICEF, New York, 2004.
3. Badshah S, Mason L, McKelvie K, Payne R, Lisboa PJG. Risk factors for low birth weight in the public-hospitals at Peshawar, NWFP-Pakistan. BMC Public Health 2008, 8: 197
4. Borja JB, Adair LS: Assessing the net effect of young maternal age on birth weight. Am J Hum Biol 2003, 15: 733-40.
5. Valero De Bernabé J, Soriano T, Albaladejo R, Juarranz M, Calle ME, Martmnez D, Dommguez-Rojas V: Risk factors for low birth weight: a review. Eur J Obstet Gynecol Reprod Biol 2004; 116: 3-15.
6. Goldenberg RL, Rouse DJ: Prevention of premature birth. New England Journal of Medicine 1998, 339; 313-20.
7. Boardman JD, Finch BK, Hummer RA: Race / ethnic differences in respiratory problems among a nationally representative cohort of young children in the United States. Popul Res Policy Rev 2001; 20: 187-206.
8. Blanc A, Wardlaw T. Monitoring low birth weight: an evaluation of international estimates and an updated estimation procedure. Bulletin of the World Health Organization 2005; 83: 178–85.
9. Wardlaw T, Blanc A, Ahman E: LBW: country, regional and global estimate. New York: United Nations Children's Fund and World Health Organization; 2004.
10. Roudbari M, Yaghmaei M, Soheili M: Prevalence and risk factors of low-birth-weight infants in Zahedan, Islamic Republic of Iran. East Mediterr Health J 2007; 13: 838-45.
11. Bukowski R, Smith GCS, Malone FD, Ball RH, Nyberg DA, Comstock CH, Hankins GD, Berkowitz R, Gross SJ, Dugoff L, Craigo SD, Timor- Tritsch IE, Carr SR, Wolfe HM, D'Alton ME: Fetal growth in early pregnancy and risk of delivering LBW infant: prospective cohort study. BMJ 2007; 334: 836-91.
12. Krieger N, Smith GD. "Bodies Count," and Body Counts: Social Epidemiology and Embodying Inequality. Epidemiol Rev 2004; 26: 92-103.
13. Baptiste-Roberts K, Salafia CM, Nicholson WK, Duggan A, Wang NY, Brancati FL. Maternal risk factors for abnormal placental growth: The national collaborative perinatal project. BMC Pregnancy and Childbirth 2008; 8: 44
14. El-Shazly M, Rammah AMA, Asayad A. Low birth weight among singleton primigravidae in Kuwait, Bull Alx Fac Med 2004; 40: 223-9.
15. Joyce T. Dramatic increase in the rate of low birth weight in New York City: an aggregate time-series analysis. Am J Public Health 1990; 80: 682-4.
16. MacCormick MC. The contribution of low birth weight to infant mortality and childhood morbidity. N Engl J Med 1985; 312: 82-90.
17. Bloomfield FH, Oliver MH, Hawkins P, Campbell MI, Philips DJ, Gluckman PD, Challis JR, Harding JE: A periconceptional nutritional origin for non-infections preterm birth. Science 2003; 300: 606.
18. Coutinho PR, Cecatti JG, Surita FG, De Souza JP, De Morais SS. Factors associated with low birth weight in a hospital series of deliveries in Capinas, Iran. Rev Assoc Med Bras 2009; 55: 692-9.
19. Jafari F, Eftekhar H, Pourreza A, Mousavi J. Socio-economic and medical determinants of low birth weight in Iran: 20 years after establishment of a primary healthcare network. Public Health 2010; 124: 153-8.
20. Al Eissa YA, Ba'Aqeel HS, Haque KN. Low birth weight in Riyadh, Saudi Arabia: incidence and risk factors. Annals of tropical paediatrics 1991; 11: 75–82.
21. Khalid AM. Low birth weight in the Taif Region, Saudi Arabia. EMHJ 1995; 1: 47–54.
22. Delbaere I, Verstraelen H, Goetgeluk S, Martens G, De Backer G, Temmerman M. Pregnancy outcome in primiparae of advanced maternal age. Eur J Obstet Gynecol Reprod Biol 2007; 135: 41-6.
23. Minagawa AT, Biagoline RE, Hujimuri E, de Oliveira IM, Moreira AP, Ortega LD. Low birth weight and maternal conditions in pre-natal. Rev Esc Enterm USP 2006; 40; 548-54.
24. Mansour E, Eissa AN, Nofal LM, Salam I: Incidence and factors leading to LBW in Egypt. Int J Pediatr 2002; 1:223-30.
25. Kuo CP, Lee SH, Wu WY, Liao WC, Lin SJ, Lee MC. Birth outcome and risk factors in adolescent pregnancies – results of a Taiwanese National Survey. Pediatr Int 2009 [Epub ahead of print].
26. Algert C, Roberts C, Adelson P, Frommer M. Low birth-weight in NSW, 1987: a population-based study. Aust N Z J Obstet Gynaecol 1993; 33: 243–8.
27. Harfouche JK, Verhoestrate LJ, Al-Shazai H. The state of child health in the Eastern

Mediterranean region. EMRO Technical Publication Series 9. Alexandria: EMRO 1995.
28. Kramer MS: Determinants of low birth weight: Methodological assessment and meta-analysis. Bulletin of the World Health Organization 1987, 65; 663-737.
29. Shah PS, Zao J, Knowledge Synthesis Group of Determinants of preterm/LBW births. Induced termination of pregnancy and low birth weight and preterm birth: a systematic review and meta-analyses. BJOG 2009; 116: 1425-42.
30. Bhattacharya S, Townend J, Shetty A, Campbell D, Bhattacharya S. Does miscarriage in an initial pregnancy lead to adverse obstetric and perinatal outcome in the next continuing pregnancy? BIOG 2008; 115: 1623-9.
31. Borkowski W, Mielniczuk H. The influence of social and health factors including pregnancy weight gain rate and pre-pregnancy body mass on low birth weight of the infant. Ginekol Pol 2008; 79: 415-21. (Abstract).
32. Lawoyin TO. The relationship between maternal weight gain in pregnancy, hemoglobin level, stature, antenatal attendance and low birth weight. Southeast Asian J Trop Med Public Health 1997; 28: 873-6.