The relation of low birth weight to psychosocial stress and maternal anthropometric measurements

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ABSTRACT

Objectives: To determine the relationship between low birth weight and psychological stress during pregnancy, as well as anthropometric measurements of Saudi mothers.

Methods: A total of 500 Saudi women were selected, according to weight and gestation age of their new born infants, one control was selected per one case (their weight less than 2500 grams). Data was collected from El-Shamasy Maternal and Child Hospital at Riyadh city. Four instruments were used; interview questionnaire, psychosocial scales to measure life stresses, true sheet to assess maternal anthropometric data and new form characteristics. Data was analyzed using SAS system. Analysis techniques included chi-square, odd ratio and P values at < 0.05 significance level.

Results: The results reflected an increased risk of low birth weight newborns among women who had experienced an intermediate level of stress during a period of 12 months prior to delivery. There was also an association between low birth weight newborns and maternal anthropometric measurements such as weight, height, body mass index, and upper arm circumference.

Conclusion: Saudi women who had an increasing amount of stress during pregnancy, under weight and short stature have an increased risk of having low birth weight babies. More research is needed in different regions in the Kingdom of Saudi Arabia by using the same test for stressor during pregnancy or even using different tests for measuring life stress during pregnancy.

Keywords: Psychosocial stressor, anthropometric measurements.

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One of the salient WHO's slogans of recent years is "Children's health is tomorrow's wealth". However, children are to a great extent determined by factors that operate *in utero*.[1] At birth, fetal weight is viewed as the crucial parameter that is directly related to the health and nutrition of the mother, and on the other hand, is an important determination of the chances of the newborn to survive and experience healthy growth and development.[2] Furthermore, recent data has shown an increased risk of development of adulthood diseases such as diabetes mellitus and hypertension for babies of low birthweight.[3]

WHO has defined low birthweight as a weight of less than 2500 grams at birth.[1] A recent report shows that the incidence of low birthweight is highest in Asia (21%), and lowest in Europe (6%). Throughout Africa (15%), Latin America (11%), and North America (7%).[8] The incidence of low birthweight does not only vary from country to country, but also from region to region within the same country. The estimated incidence of low birthweight in Saudi Arabia is a reported range between 4% and 14%, with the highest in the El-Taif area.[9-11]

Fetal growth and birth weight is influenced by a variety of factors, among which are: demographic

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characteristics; pregnancy medical risks; pregnancy complications; environmental risks; adequacy of antenatal care; smoking; and inadequate nutrition during pregnancy.[5,6,12-15]

One emerging factor is exposure to psychosocial stressors. Several recent researches evaluated the association between exposure to psychosocial stressor and low birthweight. Most of them have delineated a correlation between exposure to major stressful life events and the incidence of low birthweight births. They suggested that stress leads to Catecholamines release, decreased placental perfusion, and uterine irritability. All together, ultimately lead to either intrauterine growth retardation or preterm labor and produces a low birthweight newborn.[14,-18] On the other hand, some other researchers revealed such an association among Black-American women only or negated such an association.[19-22]

The relationship between nutrition in pregnancy and fetal size at birth has been investigated by several researchers, where various measures of poor nutritional status during pregnancy have been linked to unfavorable pregnancy outcome, particularly low birthweight.[4,7,18] In one of these studies, maternal weight accounted up to threefold increases the risk of having a low birthweight infant, even when controlled for other known risk factors. The study explained such correlation by poor nutrition, increased vasoconstriction, resulting in decreased available glucose and lower blood pressure leading to reduce placental perfusion.[18] Nutrition in pregnancy has been measured by several researches through maternal weight gain and anthropometric measures.[7,18,23]

Reducing the incidence of low birthweight has been a major goal of various medical and governmental organizations, but progress in achieving this objective has been slow. One of the reasons for this failure has been due to the poor understanding of the many risk factors associated with low birthweight. Such an understanding should be based on regional, rather than universal data, because women's childbearing behaviors are culturally-bound.

In Saudi Arabia, there is low female literacy, early age of marriage, high parity, short inter-pregnancy intervals, parental consanguinity, joint family system with traditional lifestyle, strong social support, and under utilization of antenatal health services.[24] The present study aims to shed some light on the association between maternal anthropometric measurement, as well as exposure to psychosocial stressors and low birthweight births in the Saudi community. This data is, indeed, essential in the design of interventions and evaluation of programs targeted to reduction of the incidence of low birthweight in the Kingdom.

Methods. The study population comprised 500 newly delivered newborn and their mothers. They were randomly selected from Saudi post-partum mothers and their newborn infants within the first 24 hours after delivery. Two hundred and fifty subjects were cases and a similar number were controls. Cases were mothers with low birthweight newborns whose gestational age was > 37 weeks and weight < 2500 grams. Controls were mothers with normal birthweight newborns whose gestational age was > 37 weeks and weight > 2500 grams.

The study was conducted at El-Shemasy Maternity and Children Hospital in Riyadh City. The hospital is a large tertiary Ministry of Health affiliated setting that offers medical services free of charge to all citizens.

Data collection was achieved through the utilization of two techniques: 1) A structured interview for collection of sociodemographic information and psychosocial stressors during pregnancy, and 2) Measurement and recording of maternal anthropometric data and newborns' weight. Hence, the tools of data collection were: a) an interview schedule for the former, and b) a check-list for the latter.

Psychosocial stressors were specified according to life stressors scale.[31] The scale covers ten different areas of stress: 1) familial; 2) marital; 3) health; 4) reproduction; 5) social; 6) academic; 7) housing; 8) legal; 9) financial; and 10) mesalenous. The scale comprised 105 stressful life events. Each life event was assigned a numerical value weight that ranged from 2 to 11.5. Subjects were asked to indicate whether they had experienced any of the listed events during the 12 months prior to delivery. The summary score on the scale was computed by adding together the numerical value of each experienced event. The numerical value score of > 136 indicated exposure to high stress, < 100 indicated exposure to low stress, and 101-135 indicated exposure to intermediate stress.

Maternal anthropometric data included height, weight, body mass index (BMI), and mid-upper arm circumference (MUAC). BMI was calculated from maternal weight in kilograms divided by maternal height in square meters. It was used for assessment of maternal obesity. Women with a BMI> 26 were considered overweight or obese. Those with MUAC < 22.1 cm were considered malnourished.

Data was analyzed using SAS (Statistical Analysis System, Cary NC). Statistical significance was defined as $P < 0.05$. Analysis techniques included X^2, Phi coefficient, contingency coefficient and univariable analyses were used to identify the variable significantly associated with low birthweight. A 95% confident interval was calculated to estimate the significance of odd ratios.

Table 1 - Distribution of mothers according to their newborn weight and general characteristic.

General characteristics	NBW N=250 No (%)	NBW N=250 No (%)	P-value
Age			
<20	14 (6)	50 (20)	P<0.05*
20-24	59 (24)	63 (26)	
25-29	65 (26)	50 (20)	
30-34	62 (25)	43 (17)	
35+	50 (20)	43 (17)	
Education			
Illiterate	160 (64)	158 (63)	P>0.05
Primary up to Secondary	68 (27)	62 (25)	
University +	22 (9)	30 (12)	
Occupation			
Unemployment	230 (92)	233 (93)	P>0.05
Employment	20 (8)	17 (7)	
Consanguinity			
Unemployment	199 (79.5)	184 (74)	P>0.05
Employment	51 (20)	66 (26)	
Parity			
One	35 (14)	73 (29)	P>0.05
Two, three, four	98 (39)	115 (46)	
Five+	117 (47)	62 (25)	
Sex of newborn			P>0.05
Male	112 (45)	133 (53)	
Female	138 (55)	117 (47)	
Antenatal visits			
Inadequate care (<5 visit)	60 (24)	74 (30)	P>0.05
Intermediate (5-8 visit)	101 (40)	101 (40)	
Adequate care (>8 visit)	89 (36)	75 (30)	
Socio-economic status			
Lower socio-economic	180 (72)	193 (77)	P>0.05
Middle socio-economic	62 (25)	48 (19)	
Upper socio-economic	7 (3)	9 (4)	
Presence of house hold helper			
Not present	176 (70)	184 (74)	P>0.05
Present	74 (30)	66 (26)	

NWB - Normal birth weight, LBW - Low birth weight, *Statistically significant

Table 2 - Distribution of mother according to their newborn birth weight and maternal anthropometric measurements.

Mother's measurements	NBW N=250 No (%)	LBW N=250 No (%)	P value
Mother's post partum weight			
<40 kg	22 (9)	58 (23)	P<0.05*
40 kg	228 (91)	192 (77)	P>0.05
Mother's height			
<140 cm	11 (4)	33 (12)	P<0.05*
140 cm	239 (96)	217 (88)	P>0.05
Mother's body mass index			
<19.8 kg/m2	20 (8)	49 (19)	P<0.05*
19.8-26 kg/m2	114 (46)	126 (50)	P>0.05
>26 kg/m2	116 (46)	77 (30)	
Mother mid arm circumference			
<22.1 cm	30 (12)	62 (25)	P<0.05*
22.1 cm	220 (88)	188 (75)	P>0.05

*Statistically significant

Table 3 - Association between low birthweight and anthropometric measurements and psychosocial stressors, odd ratios and 95% confidence interval (95% CI).

Variable	Odd ratios	95% Confidence intervals
Psycho-social stressor		
Low stressors	1.00	
Intermediate stressors	2.0*	1.2-3.2
High stressors	1.6	1.0-2.6
Mother's pre-pregnancy weight		
<40 kg	3.3*	1.9-5.6
40 kg	1.00	
Mother's height		
<140 cm	2.8	1.4-5.8
140 cm	1.00	
Mother's body mass index		
<19.8 kg/m2	2.2*	1.2-3.9
19.8 - 26 kg/m2	1.00	
>26 kg/m2	0.5**	0.4-0.8
Mother's mid arm circumference		
<22.1	2.6*	1.6-4.5
22.1	1.00	

*Statistically significant: increased risk for LBW
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Results. Table 1 shows that maternal age and parity are associated with low birthweight ($P < 0.05$). The percentage of teenage mothers who gave birth to LBW babies (20%) almost fourfold that of those who delivered NBW ones (6%). While the percentage of primiparas who gave birth to LBW babies (29%) nearly doubled that of those who delivered NBW ones (14%). Mothers' education, occupation, attendance of antenatal visits, socioeconomic status, as well as newborn's sex, were all not associated with low birthweight.

The exposure to stressful life-events during pregnancy is associated with low birthweight ($P < 0.05$). The percentage of mothers with low birthweight babies who were exposed to intermediate stressors during pregnancy (25%) almost double that of mothers who experienced the same level of stress and gave normal birthweight babies (17%). Among the mothers who were exposed to low stressors, 66% gave normal and 52% gave low birthweight babies.

Table 2 reveals that mothers' anthropometric measurements are associated with low birthweight. The percentage of underweight mothers who gave birth to LBW babies (23%) nearly three folded that of the same weight group mothers who delivered NBW babies (9%). The difference is statistically significant ($P < 0.05$). The same pattern is observed in relation to maternal height; 12% LBW compared to 4% NBW among mothers with shot status. Again, the difference is statistically significant ($P < 0.05$). Only 8% of mothers of NBW babies were under weight, compared to 19% of mother of LBW ones (P

0.05). The same pattern is noticed in relation to mothers MUAC; only 12% of NBW mothers were malnourished compared to as much as 25% of mothers of LBW ones ($P < 0.05$).

The estimated odd ratios that measure the degree of association between risk factors and low birthweight and their corresponding confidence intervals for significant maternal variables are displayed in Table 3.

The results of the present study revealed an association between low birthweight and each of the maternal age and parity. This is in line with the findings of several researches.[15,17,25] They all ascertained that low birthweight is associated with primiparity and teenage pregnancy. However, Moore et al had negated the association of low birthweight with parity. Furthermore, he revealed that low birthweight risk increases with increased maternal age.

Although the association between mother's exposure to stress during pregnancy and increased risk of low birthweight babies is well documented in the literature[14-18] yet some researches had negated such an association. McCormick et al found that stressful life events had a negative effect on birthweight, but the effect became non significant when controlled for smoking.[26] Nordentoft et al found no association between psychosocial stress and intrauterine growth retardation.[27] The results of the study revealed an association between low birthweight births and exposure to intermediate stressors during pregnancy, and not to high stressors. This could be explained by the fact the Saudi society is characterized by the presence of strong social support among family, relatives, and other society members, where they tend to help each others in stressful times.

Discussion. The influence of maternal malnutrition on birthweight has gained special interest in view of the possible nutritional interventions. Anthropometry provides a simple, reliable and low-cost method of assessing maternal nutrition status.[28] A large body of evidence suggests that pre-pregnancy weight and antenatal weight gain are important determinants of fetal growth.[4,7,18] This may seem in line with the findings of the present study, yet comparison is difficult because the researchers have measured postpartum weight whereas most other studies used pregnancy weight. Few, on the other hand, had used postpartum weight and came up with comparable findings.[23,29]

In the present study, women who were short (< 140 cm) appeared to have a significantly higher risk of low birthweight. This is in accordance with the findings of Wen et al and Mavalanker et al.[17,30] Maternal height could effect intrauterine growth through either genetic or environmental mechanisms. Part of the mother's genetic potential would be passed on to the fetus, and any deficit in her stature could impose physical limitations on the growth of the uterus, placenta and fetus.

Body mass index in the study was significantly associated with low birthweight. The smaller the body mass index, the greater the chance that the mother will give a low birthweight infant. This result is supported by findings of Madani et al, and Moore et al.[10,22]

Some studies suggest that higher infant birthweights are associated with an increase in maternal upper arm subcutaneous fat. Where maternal upper arm circumference is greater in mothers, who had normal birthweight babies, compared with that of those who delivered low birthweight babies.[10,28] The results of the present study are in accordance with the above mentioned findings.

In conclusion, exposure to psychosocial stressors during pregnancy and poor maternal anthropometric measurement are directly associated with increased risk of low birthweight among the study subjects. Further studies are needed before generalization of the findings to all Saudi women.

References

1. WHO, UNICEF. Low birthweight; A tabulation of available information. Geneva, WHO 1992.
2. Winkvist A, Mogren I, Hogberg U. Familial patterns in birth characteristics, impact on individual and population risk. Int J Epidemiol 1998; 27: 248-254.
3. Curban GC, Willet WC, Rimm EB. Birth weight and adult Hypertension, diabetes Mellitus, and obesity in US men. Circulation 1996; 94: 3246-3250.
4. Maher JE, Robbart L, Goldenberg RL, Tamura T, Cilver S, Kelleye E et al. Indicators of maternal nutritional status and birthweight in terms deliveries. Obstet & Gynecol 1993; 81: 165-169.
5. Rodriguez C, Regidor E, Gutierrz-Fisac JL. Low birthweight in Spain associated with sociodemographic factors. J Epidemiol & Comm Health 1995; 49: 24-38.
6. Henriksen TB, Hendegaard M, Secher NJ. The relation between psychosocial job delivery and low weight for gestational age. Int J Epidemiol 1994; 32: 4.
7. Carmicheal S, Abrams B, Selvin ST. The pattern of maternal weightgain with good pregnancy outcome. Am J Pub Health 1997; 87:
8. Baker DJP editor. Foetal and infant origins of adult disease. London: BMJ 1998.
9. Al-Eissay, Baíageel H, Haque K. Low birthweight in Riyadh, Saudi Arabia: Incidence and risk factors. Ann Trop Paediatr 1991; 11: 75-82.
10. Madani KA, Nassrat HA, Al-Nowwaisser AA, Rufaida H, Khshoggi, Bahaa A. Low birthweight in the Taif region, Saudi Arabia. Eastern Mediterranean Health J 1995; 1: 47-54.
11. Cliver SP, Goldenberg RL, Cutter GR, Hoffman HJ, Copper RL, Gotlieb S et al. The relationships among psychosocial profile, maternal size, and smoking in predicting fetal growth retardation. Obstet Gynecol 1992; 80: 262-267.
12. Wadhwa P, Sandman C, Porto M. The association between prenatal stress and infant birth weight and gestational age at birth: A prospective investigation. Am J Obstet Gynecol. 1990; 169: 858-865.
13. Orr ST, James SA, Miller CA, Barakat B, Diaikoku N,Pupkin M et al. Psychosocial stressors and low birthweight in an urban population. Am J Prev Med 1996; 12: 459-466.

14. Rothberg AD, Lits B. Psychosocial support for maternal stress during Pregnancy: Effect on birthweight. Am J Obstet Gynecol 1991; 165: 403-407.
15. Mutale T, Creed F, Maresh M. Life events and low birthweight analysis by infants preterm and small for gestational age. Br J Obstet Gynecol 1991; 98: 166-172.
16. Norbeck J, Anderson NJ. Psychosocial predictors of pregnancy outcomes in low income black Hispanic and white women. Nursing research. 1989; 38: 204-209.
17. Mavalankar DV, Gray RH, Trivedi CR. Risk factors for preterm and term low Birthweight in Ahmedabad, India. Int J Epidemiol 1992; 21: 263-272.
18. Wolfe CD, Linton EA. Stress signals from the mother, fetus and placenta. Contemp Rev Obstet Gynecol 1990; 2: 133-140.
19. Haddad F. Effect of anxiety in pregnancy. Contemp Rev Obstet Gynecol 1989; 1.
20. Brooke OG, Anderson HR, Bland JM, Peacock L, Stewarte M. Effects on birthweight of smoking, alcohol, caffeine, socioeconomic factors, and psychosocial stress. Br Med J 1989; 298: 795-801.
21. Barnett BE, Hanna B, Parken G. Event scales for obstetric groups. Journal of Psychosomatic Researches 1983: 24; 4: 313-320.
22. Moore ML, Michielutte R, Meis P, Ernest J, Wells H, Buescher P. Etiology of low birthweight: A population-based study. Prev Med 1994: 23: 793-799.
23. Goldenberg RL, Hoffman HJ, Cliver SP, Cutter GR, Nelson KG, Cupper RL. The influence of previous low birthweight on birthweight, gestational age, and Anthropometric measurements in the current pregnancy. Obstet Gynecol 1992; 79: 276-280.
24. Rasheed P, Rahman J. Predictors of Saudi birthweight: A Multiple regression Analysis. Saudi Medical Journal 1995; 16: 23-29.
25. Goldenberg RL, Davis R, Suzanne P, cliver BA, Cutter G, Hoffman H et al. Maternal risk factors and their influenced onfetal Anthropometric measurements. Am J Obstet Gynecol 1993: 1197-1205.
26. McConnick M, Brooks G, Shoter T, Holmes H, Wallace CY, Heagarty MC. Factors associated with smoking in low income pregnant women: Relationship to birthweight, stressful life events, social support, health behaviors, and mental distress. J Clin Epidemiol 1990; 43: 441-448.
27. Nordentaft M, Lou H, Hansen D, Nim J, Pryds O. Intrauterine growth retardation and premature delivery: The influence of maternal smoking and psychosocial factors. Am J Public Health 1996; 86: 347-354.
28. Al Eissa Y, BaAgeel H, Haque K, Abobaker A, AlKarfy T, Al Khashoggi T et al. Determinants of term intrauterine Growth Retardation; The Saudi Experience. Am J O Perinatology 1995; 12.
29. Ferraz E, Gary R, Cunha T. Determinations of preterm delivery and intrauterine growth retardation in North-East Brazil. Int J Epidemiol 1990; 19: 101-108.
30. Wen S, Goldenberg R, Cutter G, Hoffman J, Cliver P. Intrauterine growth retardation and preterm. Delivery: prenatal risk factors in an indigent population. Am J Obstet Gynecol 1990; 162: 213-218.
31. Al Madi WM. Some of the psychosocial characteristics of persons more vulnerable to the stress response. Riyadh: King Saud University 1994. Unpublished thesis.