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Effect of Maternal Malnutrition on Infant Birth Weight in Gaza Governorate

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Abstract:

Objective: *This study was undertaken to reveal the effect of maternal malnutrition on infant birth weight, to assess the nutritional status of pregnant women,* ***Subjects and methods***: *A case control study was carried out at Al Shifa Hospital. 100 full term low birth weight infants and 200 full term normal birth weight infants and their mothers were included in the study. Data was collected through direct methods that included hematological information and indirect methods through a structured interview questionnaire.* ***Results***: *A lot of maternal anthropometric and nutritional factors were significantly related to infant birth weight positively; which include height, gestational weight gain, gestational age, poverty, mother education, life style.* ***Conclusion***: *This research has indicated that maternal malnutrition will affect the infant birth weight through different variables and provides possible intervention strategies that could contribute to reduce infants low birth weight in the Gaza Strip.* ***Recommendation:*** *Establish a policy and strategy by decision makers in order to improve nutritional status of pregnant women, presence of nutritionist in clinics and schools.*

Key words: Maternal malnutrition; low birth weight infant; pregnant food habit.

Introduction:

From the early moment of life until death, an appropriate supply of food supports optimum growth, maturation, mental, physical well-being and resistance to disease. All people need the same nutrients, but these amounts differ through the life span (Schlenker and Long, 2007; Whitney et al., 2007).

Pregnancy is a natural phenomenon during which pregnant women encounter a lot of internal physical and emotional changes, including gained of supporting tissue as growth of placenta, altered blood composition, increased blood volume by increasing plasma volume

about 1500 ml in the 34 week, also red cell mass rises by about 200-250 ml and the increase is greater when additional iron supplements are given, capacity for oxygen transport is raised by increased red cell mass, this fall may be partly due to increased glomerular filtration which results in increased urinary excretion of some amino acids, several vitamins and minerals (Williamson, 2006). Gestation is also characterized by exceedingly rapid fetus growth and development until a fully developed infant weighing about 2500 to 4000 g. So women entering pregnancy with full nutrient stores, good eating habit and healthy body weight will have optimal pregnancy, so nutrition before and during pregnancy affect both present and future development of the infant (Whitney et al., 2007).

Appropriate pre pregnancy weight benefits pregnancy outcome; while underweight women would have a high risk of having a low birth weight (LBW) infant, especially if she is unable to gain sufficient weight during pregnancy. On the other hand, overweight and obese women will have obstetric complication, and their infants face many problems (Whitney et al., 2007).

Pregnant adolescents have more miscarriages, premature births and LBW than adult pregnant women, this makes adolescent pregnancy a major public health problem. So, nutritional needs during teenage pregnancy are higher than those of adults, because they are still growing in height and physical maturation (Whitney et al., 2007).

Low pre pregnancy body mass index (pBMI) could be responsible for high intrauterine growth restriction (IUGR) rates seen among the poor in many developing countries (Scrimshaw and Schurch, 1998). IUGR is associated with poor cognitive and neurological development for the infant and in adulthood, increased susceptibility to cardiovascular disease, diabetes and renal disease (Okwu et al., 2007).

Some pregnant complication decrease food intake as heartburn especially in short stature women because the baby has less space to grow and stretch. Nausea and vomiting can affect the amount of food eaten. Craving and appetite changes during pregnancy lead to increase intake certain nutrient and neglecting the others which may lead to malnutrition (Holman, 1987).

As inferred from the literature, Malnutrition continues to be a major health burden in developing countries. It is the most important risk factor for illness and death, with hundreds of millions of pregnant

women and young children particularly affected (Muller & Krawinkel, 2005). Poor nutrition in pregnancy in combination with infections is a common cause of maternal and infant mortality and morbidity, LBW and IUGR., and LBW babies have increased risk of mortality, morbidity and development of malnutrition throughout life (Pena and Bacallao, 2002).

Overpopulation, more commonly seen in developing countries, can reduce food production, leading to inadequate food intake or intake of foods of poor nutritional quality. Conversely, the effect of malnutrition on individuals can create and maintain poverty, which can further hamper economic and social development and contributes to unsustainable resource use and environmental degradation. (Muller and Krawinkel, 2005).

Subjects and Methods

The study was conducted to reveal the effect of maternal malnutrition on infant birth weight. This study is a hospital-based case-control study. A case control study that compares two groups of people: those with the disease or condition under study (cases) and a very similar group of people who do not have the disease or condition (controls), determines the relative importance of a predictor variable in relation to the presence or absence of the disease, and looks back at what happened to each subject (retrospective study), those subjects are selected on the basis of the outcome of interest. This study was carried out at Obstetric Departments at Al Shifa hospital which is the largest governmental hospital in the Gaza Strip. The study started in November 2008, by conducting the administrative procedures and gaining ethical approval and continued to the end of July 2009. Twins, premature (gestational age of less than 37 gestational weeks) and Infants born to either hypertensive or diabetic mothers are excluded from our study.

Data was collected through direct and indirect methods. Direct methods included measuring of biochemical test, anthropometric information (measurement of weight, height, post-delivery weight of mother, and measuring the weight of their infants directly after delivery). Indirect data collection was carried out through highly structured interviews questionnaire.

The research obtained the necessary approval to conduct the study from the director general of hospitals in the Gaza Strip, the director general of Al Shifa hospital and Helsinki committee in Gaza Strip. Furthermore, agreement of mothers to participate in the study was also taken. Confidentiality and privacy: Information obtained from women was kept confidential.

Pilot study was conducted prior to the beginning of data collection to know the reliability and validity in the research design, and clarify areas of ambiguity and suitability of the questionnaire. Statistical analysis by statistical package for social science (SPSS version 18) was used for data entry, cleaning and analysis. Chi-square test was the statistical tool used to test the differences between cases and controls variables. t test for differences between means is also conducted, P- value < 0.05 is considered statistically significant.

Results

This study showed variations in demographic factors, socioeconomic status, obstetric history, maternal and fetal physical characteristics, anthropometric measurements, blood analysis, physical activity and nutritional habits among the two groups.

Maternal Characteristics:

Socioeconomic Characteristics:

Age:

A total of 300 mothers with a mean age of 24.62 years, SD=5.76 (minimum=16; maximum=44) were included in this study. The average age of cases was 24.82 years, SD= 5.97 nearly equal to the average age of controls (24.52 years, SD=5.66).

Table 1 shows that 80.3% of the total study population were between 19-34 years old; about 82% and 79.5% of them gave birth to LBW and normal birth weight (NBW) infants respectively, the differences between cases and controls did not reach statistical significance (P-value = 0.876).

Citizenship:

Table 1 shows about half (50.3%) of participants were refugee. Although citizen gave birth to LBW infants more than refugees (57%), the differences didn't reach statistical significance.

Residency:

In table 1; about 80.3% of participants live outside the camp, from them 82% gave birth to LBW infants and about 79.5% gave birth to NBW infants. While 19.7% of participants lived in the camp, about 18% gave birth to LBW infants and 20.5% gave birth to NBW infants.

Table 1: Relationship between Maternal Socioeconomic Status and Infant Birth Weight:

Variables	Mothers of LBW infants No. (%)	Mothers of NBW infants No. (%)	Total No. (%)	P-value
Age groups (years)				
<19	11 (11)	25 (12.5)	36 (12)	0.876
19-34	82 (82)	159 (79.5)	241 (80.3)	
>34	7 (7)	16 (8)	23 (7.7)	
Total	100 (100)	200 (100)	300 (100)	
Citizenship				
Refugee	43 (43)	108 (54)	151 (50.3)	0.072
Citizen	57 (57)	92 (46)	149 (49.7)	
Total	100 (100)	200 (100)	300 (100)	
Residency				
Camp	18 (18)	41 (20.5)	59 (19.7)	0.6
Outside the camp	82 (82)	159 (79.5)	241 (80.3)	
Total	100 (100)	200 (100)	300 (100)	
Mother's occupational status				
Working	5 (5)	18 (9)	23 (7.7)	0.22
Not working	95 (95)	182 (91)	277 (92.3)	
Total	100 (100)	200 (100)	300 (100)	
Mother's educational level				
Illiterate	4 (4)	1 (0.5)	5 (1.7)	0.019*
Primary	12 (12)	9 (4.5)	21 (7)	
Preparatory	26 (26)	50 (25)	76 (25.3)	
Secondary	37 (37)	90 (45)	127 (42.3)	
University & higher	21 (21)	50 (25)	71 (23.7)	
Total	100 (100)	200 (100)	300 (100)	
Income meet expenses				
Yes	37 (37)	99 (49.5)	136 (45.3)	0.04*
No	63 (63)	101 (50.5)	164 (54.7)	
Total	100 (100)	200 (100)	300 (100)	

Service provider♦				
MOH	37 (38.5)	57 (29.4)	94 (32.4)	0.272
UNRWA	34 (35.4)	83 (42.8)	117 (40.3)	
Private	25 (26)	54 (27.8)	79 (27.2)	
Total	96 (100)	194 (200)	290 (100)	
Smoking of husband				
Yes	44 (44)	71 (35.5)	115 (38.3)	0.328
No	56 (56)	129 (64.5)	185 (61.7)	
Total	100 (100)	200 (100)	300 (100)	

**Statistical significant. (P value <0.05).*

♦Only 290 participants had service providers, the remainder hadn't.

Mother's Occupational Status:

Regarding occupational status, table 1 shows the great majority (92.3%) of study population were housewives and only 7.7% were employed or students, so the rate of work among participants is 7.7%, about 5% of mothers gave birth to LBW infants and 9% of mothers gave birth to NBW infants were employed. In contrast 67% of their husband were employed. The differences between cases and controls wasn't statistically significance (P-value = 0.22).

Educational Level:

Table 1 shows that less than half of participants (42.3%) completed their secondary school education, from them 37% of mothers gave birth to LBW infants and 45% of mothers gave birth to NBW infants, 23.7% were university graduate, from them 21% of mothers gave birth to LBW infants and 25% of mothers gave birth to NBW infants and only 1.7% of them were illiterate, from them 4% of mothers gave birth to LBW infants and 0.5% of mothers gave birth of NBW infants, it was statistically significance (P-value = 0.019).

Monthly Income:

Table 1 shows that the monthly income would not meet expenses in 54.7% of participants, mothers whose income did not meet expenses gave birth to LBW constituted 63%. There were significant differences between cases and controls regarding monthly income (P-value = 0.04).

Obstetrical History:

Marital age:

As shown in table 2, the study revealed that 53% of subjects got married before 19 years old. whilst, the mean age of marriage for study population was 18.95 years (minimum=13, maximum= 33, SD= 3.17), the mean marital age for mothers given LBW babies was 19.1 years (SD=3.55) and for mothers who gave birth to NBW babies was 18.84 years (SD=2.97). Early marriage is more apparent among those gave birth of NBW babies (54.5% married before 19 years old) compared to 50% of mothers who gave birth to LBW babies. The difference between cases and controls did not reach statistical significance (P-value = 0.462).

Parity:

Number of deliveries didn't reveal a significant differences among subjects in which, the percentage between cases and controls was nearly similar, but 21% of mothers who gave birth to LBW infants had 6 and more deliveries compared to 20.5% of mothers who gave birth to NBW infants. The differences between cases and controls did not reach statistical significance (P-value = 0.92) as shown in table 2.

History of Stillbirth:

As shown in table 2, the percentage of mothers who gave birth to LBW infants and had a history of stillbirth were two times more than that of mothers who gave birth to NBW infants 10% and 5% respectively, the differences among cases and controls didn't reach statistically significance (P-value = 0.102).

History of Abortion:

Table 2 shows that the percentage of a positive history of abortion was higher among mothers who gave birth to LBW infants (30%) than among mothers who gave birth to NBW infants (27.5%). The difference between cases and controls did not reach a statistical significance (P- value = 0.651).

History of Previous LBW:

Table 2 shows that the percentage of mothers with the history of giving birth to LBW infants before and gave birth to LBW infants is higher (16%) than the percentage of mothers who gave birth to NBW infants (9%). The difference between cases and controls did not reach a statistical significance (P-value = 0.071).

Table 2: Relationship between Maternal Obstetric History and Infant Birth Weight:

Variables	Mothers of LBW infants No. (%)	Mothers of NBW infants No. (%)	Total No. (%)	P-value
Marital age (years)				
<19	50 (50)	109 (54.5)	159 (53)	0.462
≥19	50 (50)	91 (45.5)	141 (47)	
Total	100 (100)	200 (100)	300 (100)	
Parity				
1-5	79 (79)	159 (79.5)	238 (79.3)	0.92
≥ 6	21 (21)	41 (20.5)	62 (20.7)	
Total	100 (100)	200 (100)	300 (100)	
History of stillbirth				
Yes	10 (10)	10 (5)	20 (6.7)	0.102
No	90 (90)	190 (95)	280 (93.3)	
Total	100 (100)	200 (100)	300 (100)	
History of abortion				
Yes	30 (30)	55 (27.5)	85 (28.3)	0.651
No	70 (70)	145 (72.5)	215 (71.7)	
Total	100 (100)	200 (100)	300 (100)	
History of previous LBW				
Yes	16 (16)	18 (9)	34 (11.3)	0.07
No	84 (84)	182 (91)	266 (88.7)	
Total	100 (100)	200 (100)	300 (100)	
Birth interval▫				
<24 months	44 (67.7)	94 (71.8)	138 (70.4)	0.557
≥24 months	21 (32.3)	37 (28.2)	58 (29.6)	
Total	65 (100)	131 (100)	196 (100)	

▫*For multipara mother.*

Maternal Malnutrition:

Maternal Body Mass Index (BMI):

Generally, the mean maternal BMI was 23.866kg/m² (SD= 3.94, minimum= 16.02 kg/m², maximum= 36.9 kg/m²), the mean maternal BMI for mothers who gave birth to LBW infants was 24.36 kg/m² (SD=3.95) compared to 23.69kg/m² (SD= 3.94) for mothers who gave birth to NBW infants. The percentage of mothers with ideal, overweight and obese BMI was nearly the same between cases and

controls. The difference between cases and controls didn't reach statistical significance (P- value= 0.661) (Table 3).

Table 3: Relationship between Maternal Anthropometric Measurements and Infant Birth Weight:

Variables	Mothers of LBW infants No. (%)	Mothers of NBW infants No. (%)	Total No. (%)	P-value
Maternal height (cm.)				
≤ 150	17 (17)	2 (1)	19 (6.3)	0.000*
>150	83 (83)	198 (99)	281 (93.7)	
Total	100 (100)	200 (100)	300 (100)	
Gestational weight gain [a]				
Recommended	12 (26.7)	71 (55)	83 (47.7)	0.000*
Less than recommended	25 (55.5)	26 (20.2)	51 (29.3)	
More than recommended	8 (17.8)	32 (24.8)	40 (23)	
Total	45 (100)	129 (100)	174 (100) [b]	
Body mass index (kg/m$^{2)}$ [a]				
Underweight (< 18.5)	1 (2.2)	9 (7)	10 (5.7)	0.661
Healthy (18.5-24.9)	26 (57.8)	75 (58.1)	101 (58.1)	
Over weight (25-29)	14 (31.1)	34 (26.4)	48 (27.6)	
Obese (≥30)	4 (8.9)	11 (8.5)	15 (8.6)	
Total	45 (100)	129 (100)	174 (100) [b]	

**Statistical significant.*

[a] Gestational Weight Gain and BMI categorized according to Rolfes et al., (2006).

[b] BMI and gestational weight gain could be obtained only for 174 mothers; as the weight of mother at first trimester was not available for all pregnant mothers in the primary health care centers.

Hematological Tests:

Hemoglobin (Hb) Prior to Delivery:

The study revealed that 33.3% of all participants were anemic (Hb < 11 g/dl). Generally, the mean hemoglobin among population prior to

delivery was 11.1 g/dl (SD= 1.16, minimum=7g/dl, maximum=14.2g/dl). Whereas, the mean was 11.17g/dl (SD= 1.2) among mothers who gave birth to LBW infants and 11.08g/dl (SD=1.14) among mothers who gave birth to NBW infants, 32% and 34% of mothers who gave birth to LBW and NBW infants were anemic respectively. The difference between cases and controls did not reach a statistical significance (P-value= 0.563, t- test= 0.579) (Table 4).

Hemoglobin during Pregnancy:

The study revealed that generally the mean Hb level during pregnancy was 10.81g/dl (SD=1.135, minimum= 8g/dl, maximum= 14 g/dl), the mean HB level was 10.75 g/dl (SD= 0.99) among mothers who gave birth to LBW infants, and 10.83 g/dl (SD= 1.198) among who mothers gave birth to NBW infants. Hemoglobin during pregnancy was obtained for 276 participants only, the remainder wasn't available. Nearly 39.3% of mothers who gave birth to LBW infants and 42.2% of mothers who gave birth to NBW infants were anemic. The differences between cases and controls didn't reach statistical significance (P- value= 0.572) (Table 4).

Table 4: Comparison of Means between Maternal Hematological Tests and Infant Birth Weight.

Variable	Category	Mean	SD	t-test	P-value
Hemoglobin prior to delivery (g/dl)	Mothers of LBW infants Mothers of NBW infants	11.17 11.08	1.20 1.14	0.58 0.57	0.563
Hemoglobin during pregnancy (g/dl)	Mothers of LBW infants Mothers of NBW infants	10.75 10.83	0.99 1.20	-0.567 -0.605	0.572
Serum iron (µg/dl)	Mothers of LBW infants Mothers of NBW infants	67.0 76.2	29.6 29.9	-1.440 -1.445	0.153

Serum Iron:

The researcher classified serum iron into two categories; less than 50µg/dl and normal from 50 to 175µg/dl. Only 100 participants were anemic and measured serum iron for them, the mean serum iron concentration among participants were 73.257 µg/dl (SD= 29.97, minimum= 28, maximum= 175), the mean was 67.0 µg/dl among mothers who gave birth to LBW infants and 76.2 µg/dl among mothers who gave birth to NBW infants. About 21.9% of mothers who gave birth to LBW infants and 11.8% of mothers who gave birth to NBW infants with serum iron less than 50µg/dl. But the difference between cases and controls didn't reach a statistical significance (P-value =0.153) (Table 4).

Food Intake during Pregnancy:

Protein:

Table 5 shows those different types of food and the rate of food intake during pregnancy. About 36.5% of mothers who gave birth to NBW infants and 23% of mothers who gave birth to LBW infants took protein daily, while 31% of mothers who gave birth to NBW infants and 44% of mothers who gave birth to LBW infants took protein monthly. The differences between cases and controls were statistically significance (P- value= 0.03).

Carbohydrates:

Table 5 shows about 80% of mothers who gave birth to NBW infants and 69% of mothers who gave birth to LBW infants took simple carbohydrates such as bread many times daily and in large quantities, and 20% of mothers who gave birth to NBW infants and 31% of mothers who gave birth to LBW infants took carbohydrates few times daily and in small quantities. The differences between cases and controls were statistically significance (P- value= 0.035).

Dessert:

About 238 participants took dessert during pregnancy, about 67.6% of them gave birth to NBW infants, and the remainder gave birth to LBW infants. Nearly 45% of mothers who gave birth to NBW infants took dessert daily; about 35.5% of them took it weekly, while 29% of mothers who gave birth to LBW infants took dessert daily and 48% took it weekly and this was statistically significance (P-value= 0.026) (Table 5).

Fruits and Vegetables:

About 69% of mothers who gave birth to NBW infants and 64% of mothers who gave birth to LBW infants took fruits and vegetables daily. The differences between cases and controls did not reach statistical significance (P- value= 0.283) (Table 5).

Consuming Fish:

In table 5, about 83% of mothers gave birth of NBW infants and 85% of mothers gave birth of LBW infants consumed fish during pregnancy, from them 53%of mothers gave birth of NBW infants and 51.8% of mothers gave birth of LBW infants consumed fish once or more weekly, but this didn't reach statistical significance (P- value= 0.851).

Table 5: Relationship Between Frequency of Foods Taken During Pregnancy and Infant Birth Weight:

Variables	Mothers of LBW infants No. (%)	Mothers of NBW infants No. (%)	Total No. (%)	P-value
Protein				
Daily	23 (23)	73 (36.5)	96 (32)	0.03*
Weekly	33 (33)	65 (32.5)	98 (32.7)	
Monthly	44 (44)	62 (31)	106 (35.3)	
Total	100 (100)	200 (100)	300 (100)	
Carbohydrates				
Many times daily	69 (69)	160 (80)	229 (76.3)	0.035*
Few times daily	31 (31)	40 (20)	71 (23.7)	
Total	100 (100)	200 (100)	300 (100)	
Dessert				
Never eat it	23 (23)	39 (19.5)	62 (20.6)	0.026*
Daily	29 (29)	90 (45)	119 (39.7)	
Weekly	48 (48)	71 (35.5)	119 (39.7)	
Total	100 (100)	200 (100)	300 (100)	
Fruits and Vegetables				
Daily	64 (64)	138 (69)	202 (67.3)	0.283
Weekly	36 (36)	62 (31)	98 (32.7)	

Total	100 (100)	200 (100)	300 (100)	
Fish				
Yes	85 (85)	166 (83)	251 (83.7)	0.659
No	15 (15)	34 (17)	49 (16.3)	
Total	100 (100)	200 (100)	300 (100)	
Rate of taking fish▶				
Once or more weekly	44 (51.8)	88 (53)	132 (52.6)	0.851
Once or more monthly	41 (48.2)	78 (47)	119 (47.4)	
Total	85 (100)	166 (100)	251 (100)	

**Statistically Significant.*
▶The rate for those consuming fish.

Maternal Nutritional Habits:

Numbers of Meals:
Nearly 28% of participants ate less than three meals and this percentage was more among mothers who gave birth to LBW infants (31%). But differences between cases and controls didn't reach statistical significance (P-value= 0.705) (Table 6).

Table 6: Relationship between Maternal Diet Habits during Pregnancy and Infant Birth Weight

Variables	Mothers of LBW infants No. (%)	Mothers of NBW infants No. (%)	Total No. (%)	P-value
Numbers of meals				
<3 meals	31 (31)	53 (26.5)	84 (28)	0.705
3 meals	57 (57)	120 (60)	177 (59)	
>3 meals	12 (12)	27 (13.5)	39 (13)	
Total	100 (100)	200 (100)	300 (100)	
Maternal preferred meal				
Breakfast	15 (15)	47 (23.5)	62 (20.7)	0.171
Lunch	81 (81)	142 (71)	223 (74.3)	
Dinner	4 (4)	11 (5.5)	15 (5)	
Total	100 (100)	200 (100)	300 (100)	
Eating breakfast daily				
Yes	60 (60)	133 (66.5)	193 (64.3)	0.004*

Sometimes	10 (10)	37 (18.5)	47 (15.7)	
No	30 (30)	30 (15)	60 (20)	
Total	100 (100)	200 (100)	300 (100)	
Craving during pregnancy				
Yes	22 (22)	67 (33.5)	89 (29.7)	0.04*
No	78 (78)	133 (66.5)	211 (70.3)	
Total	100 (100)	200 (100)	300 (100)	

**Statistically Significant.*

Maternal Preferred Meal:

About 74.3% of participants preferred lunch as a basic meal followed by 20.7% of them preferred breakfast and 5% preferred dinner, but the differences between cases and controls didn't reach statistical significance (P-value= 0.171). This study found that about 59% of participants ate three meals daily, about 60% of them were among mothers who gave birth to NBW infants (Table 6).

Eating Breakfast:

As shown in table 6, about 64.3% ate breakfast daily, 60% of mothers who gave birth to LBW infants and 66.5% of mothers who gave birth to NBW infants, 20% of participants didn't eat breakfast, and about 30% of mothers who gave birth to LBW infants and 15% of mothers who gave birth to NBW infants didn't eat breakfast. The differences between cases and controls were statistically significance (P- value= 0.004). This study revealed that the main reason for non-eating breakfast was working at home or at the job.

Craving during Pregnancy:

As shown in table 6, about 29.7% of participants were craving during pregnancy, 35.5% of mothers who gave birth to NBW infants and 22% of mothers who gave birth to LBW infants craved during pregnancy, the differences between them was statistically significance (P- value= 0.04).

Food Supplements:

As shown in table 7, more than half of study population (77%) took supplements during pregnancy, about 81% of mothers who gave birth to NBW infants and 69% of mothers who gave birth to LBW infants took supplements during pregnancy. The differences between cases and controls were statistically significance (P- value= 0.02).

Moreover, table 7 shows more than half of total population took ferric with folic acid during pregnancy, about 69% of mothers who gave birth to NBW infants and 54% of mothers who gave birth to LBW infants took ferric with folic acid during pregnancy. The differences between cases and controls was statistically significance (P- value= 0.011), from those who took ferric with folic acid supplements (192 participants); more than half of participants 65.6% took it regularly (daily), about 67.4% of them gave birth to NBW infants and 61.1% of them gave birth to LBW infants, about 34.3% of participants took ferric with folic acid irregularly (1-5 times a week) but the differences between cases and controls didn't reach statistical significance (P-value=0.41).

Table 7: Relationship between Taking Food Supplements during Pregnancy and Infant Birth Weight.

Variables	Mothers of LBW infants No. (%)	Mothers of NBW infants No. (%)	Total No. (%)	P-value
Taking food supplements				
Yes	69 (69)	162 (81)	231 (77)	0.02*
No	31 (31)	38 (19)	69 (23)	
Total	100 (100)	200 (100)	300 (100)	
Taking ferric with folic acid				
Yes	54 (54)	138 (69)	192 (64)	0.011*
No	46 (46)	62 (31)	108 (36)	
Total	100 (100)	200 (100)	300 (100)	
Rate of taking it▶				
Regularly	33 (61.1)	93 (67.4)	126 (65.6)	0.41
Irregularly	21 (38.9)	45 (32.6)	66 (34.4)	
Total	54 (100)	138 (100)	192 (100)	

**Statistically Significant.*

▶rate of taking ferric with folic acid by pregnant women either regularly (daily) or irregularly (1-5 times weekly).

Discussion

Maternal Variables

Maternal Age

This study showed that there were very narrow variations between the mean maternal age among mothers who gave birth to (LBW) infants

(24.82 years) and those that gave birth to Normal Birth Weight (NBW) infants (24.52 years). Being less than 19 years old was not associated with having low birth weight, as the most study population age (about 241 participants) was between 19 and 34 years old. This is consistent with some literature and inconsistent with others. Stewart et al (2007) study that evaluated the effect of pregnancy during adolescence in the nutritionally poor environment and concluded that young maternal age (≤18 years) increased the risk of preterm delivery, but not intrauterine growth retardation (IUGR), for the first but not second live-born infant, each year of increasing maternal age among primiparae wasn't associated with increases in the birth weight but associated with increases in birth length, head, and chest circumference.

Socioeconomic Characteristics:

Residency and citizenship

Although being refugee women- who had both United Nations Relief and Work Agency (UNRWA) and primary health care centers in Ministry of Health (MOH) as service providers- were less likely to give birth to LBW than the citizens- who had only governmental primary health care centers in MOH as service provider, but the association didn't show statistical significance. Furthermore, women living in a camp gave birth to LBW less likely than those living outside the camp, but the association didn't reach statistical significance. This explains that there are no clear borders between Gaza population residency. Additionally, refugee women were receiving food rations which could improve their nutritional status.

Poverty:

The study concluded that having insufficient income increases significantly the risk of LBW infants as low incomes may limit access to health necessities such as an adequate diet. There is a consensus in the literature regarding the role of poverty that accelerates the rise in moderately LBW rates were associated with advancing maternal age (Collins et al, 2006).

Mother's Occupational Status

Mother's work has no effect on giving birth to LBW infant, this is because the percentage of work among women in this study was only 7.7% of the total study population, and the prevalence of those who work among those who gave birth to NBW infant were more than among those who gave birth to LBW. The literature demonstrated that the rate of LBW of women employed outside the home was less than housewives (6.6 % and 12.4% respectively) but this wasn't significant (Roudbari et al., 2007).

Educational Level:

This study revealed that increasing educational level of women showed statistical significance association with increasing weight of infants upon birth. This result agreed with a study of Chevalier and O'Sullivan. (2007) that found maternal education may affect infant health and birth weight positively, for each year increased in maternal education is estimated to increase the average birth weight by 75 g. Halileh et al. (2008) found that female infants have lower birth weights than male infants in illiterate mothers; however, birth weights of male infants were not affected by mother education. On the other hand, female birth weights increases with increasing mother education. Vahdaninia et al. (2008); Roudbari et al. (2007) and Rafati et al. (2005) found that the prevalence of LBW reduced with increasing level of education, educated mother associated positively with infant birth weight.

Obstetrical History:

Parity:

The current study revealed no significant differences between number of births and infant birth weights. More than three quarters of participants gave birth for less than six infants. This coinciding with the study of Vahdaninia (2008) which revealed no significant relationship between numbers of pregnancies and giving birth to LBW infants.

On the other hand, Varvarigou et al. (2009) and Phung et al. (2003) found that increasing parity is associated with higher birth weight in infants.

Birth Interval:

Mothers who were spacing their births for more than 24 months are less likely to give birth to LBW (32.3%) than mothers who space for

less than 24 months (67.7%) however, it didn't reach statistically significance. The Islamic religion as shown in the Holly Qura'n (Al-Bakara, 233) stated that breast feeding should be for 2 years if mothers want so, this interval enable mother to replenish nutrient stores of the body, this leads to normal infant growth of subsequent pregnancy and lead to NBW infants.

This result is consistent with the study of Hong and Ruiz-Beltran. (2008) which found that the prevalence of LBW was slightly higher among those with birth interval less than 24 months.

Zhu et al. (2003) showed that the risk for LBW was lowest when the inter pregnancy interval was 18-23 months and increased with shorter or longer intervals.

History of Previous Abortion, Preterm, LBW, Intrauterine Growth Retardation (IUGR) Birth:

In the present study, history of stillbirth, abortion and LBW were associated with increased chance of LBW but it was not statistically significant. This study is inconsistent with other study that found the prevalence of LBW for mothers who had a history of miscarriage was 7.8% less than for mothers with no history of miscarriage (12.8%) (Roudbari et al., 2007).

In contrast with other study that found pregnant women with a previous history of LBW, IUGR or preterm birth had a great risk of LBW, IUGR or preterm births in a subsequent pregnancy (Vahdaninia et al., 2008; Shah and Ohlsson, 2002).

Nutritional Determinants

Gestational Weight Gain (GWG):

Hematological Tests:

In the present study, the hemoglobin level prior to delivery was more than that during pregnancy which could be due to iron and folic acid supplements during pregnancy.

Furthermore, the mean serum iron for mothers who gave birth to LBW was less than for mothers who gave birth to NBW. These small differences in mean didn't reach statistical significance, serum iron was measured for anemic mothers those represented 100 participants only so further studies should be conducted to larger sample in order

to find out if serum iron alone plays an independent role in having LBW infants.

This result matches Elhissi. (2007) and Halileh et al. (2008) who found that the association between birth weight and anemia in mothers wasn't statistically significant.

Shah and Ohlsson. (2002) that evaluated literature found no evidence that iron supplementation

reduces the incidence of LBW births, but it improved maternal iron status. Kolte et al. (2009) found that there was a low positive correlation between the mean dietary iron intake and mean birth weight.

This work faced difficulties in obtaining hemoglobin level during pregnancy because not all pregnant mothers went to prenatal health care centers, hemoglobin level of about 92% of the total study population could be obtained, but there was no significant association between anemia during pregnancy and having LBW infants.

Food consumed during pregnancy:

Concerning food frequency questionnaire that addressed different types of food and rate of taking it, this work found that the incidence of taking these different types of food (egg, white, red meat, organs, fish, legumes, milk products, carbohydrates, fruits, vegetables, desserts, nuts and oils) were more among mothers who gave birth to NBW infants, that taking it once or more daily than among mothers who gave birth to LBW infants, but only protein, carbohydrates and desserts showed statistical significance related to having NBW.

Protein intake during pregnancy:

The current study indicates that there was a statistical significance positive relationship between taking protein daily and infant birth weight, this result is matched with the study of Schlenker and Long. (2007) and Whitney et al. (2007) who illustrated that more protein is necessary for pregnant women due to rapid fetal growth, and enlargement of the uterus, mammary glands, and placenta, increases in maternal blood volume, formation of amniotic fluid, and storage reserve for labor, delivery, and lactation.

Energy Intake during Pregnancy:

The result of this study found, there was a positive relationship with statistical significant level between increasing amount of carbohydrates and dessert taking daily and infant birth weight, that

means increasing energy intake by pregnant mothers was positively related with infant birth weight, this result is supported with other studies, Robert et al.(2006) found that infants of women eating the high glycemic index diet tended to be heavier at birth than infants of women eating the low glycemic index carbohydrates.

But this result wasn't consistent with other studies as Lenders et al. (1997) that found pregnant women consuming high sugar diets were at increasing risk of having SGA and LBW infants.

This data collection depended on women memory during the pregnancy period. Also since Gaza was under siege, this led to decrease nutritional rich food and increased its price as meat, milk products, fruits and vegetables and thus decreased its consumption by pregnant women and increased consumption of carbohydrates and desserts.

Fish consumption during pregnancy:

Consuming fish was slightly more among mothers who gave birth to LBW infants that means there is a negative relationship between consumption of fish during pregnancy and infant birth weight, this effect may be due to contamination with pollutants and toxic metals as mercury that may be deposited in fish that may accumulate in the blood stream over time and could damage infant developing brain and nervous system or due to the amount of fish consumed. This is inconsistent with Thorsdottir et al. (2004) that found infant of women in the lowest quantities of fish consumption weighed less, were shorter and had a smaller head circumference at birth than those of women consuming higher amounts of fish.

Maternal Nutritional Habits:

Regarding nutritional habits of pregnant, this work didn't reveal statistical significant level between number of meals and infant birth weight, although eating three meals or more among women who gave birth to NBW was more than among women who gave birth to LBW. This small increase in the percentage of mothers who gave birth to NBW infants may depend on the types of meals taken during pregnancy, which may be nutrient dense food.

Also by asking about the basic and favorite meal for pregnant and how this meal affect infant birth weight, this work indicated that there was no statistical significance between any types of meal and infant birth

weight, although the incidence of eating breakfast and lunch were more among mothers who gave birth to NBW infants than among those gave birth to LBW infants. This requires more prospective studies on large population size to investigate which kind of meal (breakfast, lunch or dinner) contributes to increasing birth weight.

On the other hand, the current study indicated that there was a statistical significant positive relationship between eating breakfast daily and increasing infant birth weight, in which the percentage of eating breakfast was more among those gave birth to NBW infants than among those gave birth to LBW infants, that means mothers had eating breakfast daily would have more chance to deliver NBW infant than those mothers haven't eaten breakfast, this result demonstrated the importance of eating breakfast during pregnancy, as it supply energy for pregnant woman and her fetus specially after a long fasting hours through the night.

The current study revealed significant relationship between craving and giving birth to NBW infants, in which the prevalence of craving among women who had NBW infants was more than women with LBW infants. The reason for this might be referred to the types of craving, whether it is food item craving or non-food item craving, in other word, pregnant women may have craving to nutritious diet as yogurt, meet, fish, cheese, juice or other nutrient dense food and this may lead to increase in the infant birth weight.

Rainville, 1998 didn't show any effect of craving on infant birth weight but it may affect the maternal hemoglobin level at delivery.

Supplement intake during pregnancy:

Concerning the dietary supplements, this study indicates that there was statistical significant positive association between taking supplements and infant birth weight.

This result is supported by other, Haider and Bhutta. (2006) found that multiple micronutrient supplementations resulted in a statistically decreased number of LBW babies, SGA babies and in maternal anemia. Zagre et al. (2007) showed that the mean birth weight was higher with multiple micronutrients supplements than with iron-folic acid alone.

Iron-folic acid supplement intake:

The result of this study found a positive association between taking iron with folic acid supplements with statistical significant level and

infant birth weight regardless of the rate of taking it whether daily or weekly, the result of this study was supported by the study of Christian et al. (2003) that found the antenatal folic acid and iron supplements reduce the risk of LBW more than that of multiple micronutrients supplement, so multiple micronutrients supplement didn't add benefit over folic acid and iron supplements in reducing LBW.

Timmermans et al. (2009) found that folic acid supplementation was positively associated with fetal growth and with higher birth weight and placental weight and decreased the risk of LBW and SGA compared to no folic acid supplementation. This study is inconsistent with Shah and Ohlsson. (2009) that reviewed a number of studies concerned with taking prenatal micronutrient supplements during pregnancy reduced the risk of LBW and increased infant birth weight more than taking iron-folic acid alone.

Conclusion

This research has indicated that maternal malnutrition will affect the infant birth weight through different variables. Increasing the chance in giving birth to LBW infants among citizen mothers more than refugees as the refugees were receiving food rations which could improve their nutritional status. Low socioeconomic level as low maternal educational level and low family income were associated with LBW infants. More than half of study population was poor and their nutritional needs were not met.

The research has indicated that eating breakfast daily during pregnancy was positively associated with infant birth weight. Craving for certain food during pregnancy was associated positively with infant birth weight. Increasing intake of food rich in protein, carbohydrates, dessert and consuming milk, yogurt and juice daily during pregnancy were associated with increasing infant birth weight. Consuming caffeinated beverages to more than 2 cups daily was associated negatively with infant birth weight. Iron and folic acid supplementation during pregnancy was associated positively with infant birth weight.

The present study found that LBW among female infants were more than among male infants. Increasing gestational age was significantly associated with birth weight.

Recommendations

Good nutrition status prior to and during pregnancy is associated with healthier infant outcomes. Three levels of recommendations are suggested:

1. *Recommendation to policy makers*

- Employment nutritionist in each health center to provide a suitable counseling, advice, nutritional programs and nutritional assessment.
- Educational programs to improve the mother nutritional status should be individualized according to the educational level of pregnant women.
- Designing a small booklet containing tables of different types of food and beverages and its amount for pregnant women.
- Taking care of all Palestinian pregnant women whether citizens or refugees to avoid a fear of having nutritional problems among them; by different ways as giving them a donated food, food supplements suitable for pregnant women and having good suitable services in their primary health care centers.
- Home visits for pregnant women may be helpful to make nutritional assessment, offer nutritional programs, advices, counseling and education especially for those who didn't attend the primary health centers. Improve nutritional measuring assessment as mid upper arm circumference, height, body mass index, weight gain, biochemical test for pregnant women in all health care centers in order to improve pregnant women nutritional status and subsequently enhance pregnancy outcomes.

2. *Recommendation to pregnant women*

- Encouraging women's attendance to health centers and considering factors that increase their utilization of services such as satisfaction studies, incentive programs and so on.
- Pregnant women should increase their knowledge about pregnancy, how to have a healthy baby through attending different educating programs, reading a book or magazine deals with pregnant nutrition and health.

- Pregnant women should take care of their nutritional status through eating a healthy balanced diet containing different macro and micronutrients, eating breakfast daily drinking at least three cups of milk or yogurt daily, increasing drinking of fresh juice drinks and taking food supplements as ferric with folic acid.

3. *Recommendation to community*

- Encouraging family support for pregnant mothers.
- Encourage female's education as it imparts knowledge and thus modify dietary habits and quality of food consumed.
- To have good nourished pregnant woman, this requires a good nourished childhood and adolescent girl through different nutritional programs.
- Presence of nutritionist in each school to provide nutritional advice to children.
- The role of different media is very important. So, educational programs to increase the awareness on the importance of nutritional status of women in different life span and her pregnancy outcomes.
- Further studies are needed to study independently the relationship between different nutritional problems as anemia, heart burn and vomiting on infant birth weight.
- More focused studies are required to find the association between obstetrical history, nutritional history, body mass index, smoking, age and residency.

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