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Research Article

Maternal Dietary Patterns during Early Pregnancy and Their Association with Pregnancy Outcome among Obese Women in Gaza Strip, Palestine: a Prospective Cohort Study

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Abstract

Background: Maternal nutritional status during pregnancy is the main determinant of fatal development, birth weight and disease of the infant, as well as the women's health. This study was conducted to identify major dietary patterns during early pregnancy and their association with pregnancy outcome among obese women.

Methods: The current prospective cohort study was conducted among 200 pregnant obese women during the first trimester, aged >18 years old, who receiving care in primary healthcare centers in Gaza Strip, Palestine during the years 2018 and 2019. Dietary patterns were evaluated using a validated semi-quantitative food frequency questionnaire. Additional information regarding other variables was obtained with an interview-based questionnaire. Statistical analysis was performed using SPSS version 20.

Results: Two major dietary patterns were identified by factor analysis: Asian-like pattern and Western pattern. After adjustment for confounding variables, women in the lowest quartile (Q1) of the Asian-like pattern had a lower odds for (Preterm birth, low birth weight, and congenital anomalies), (OR 0.368 CI 95% (0.187-0.726)), (OR 0.308 CI 95% (0.133-0.714)), and (OR 0.394 CI 95% (0.197-0.791)) respectively, (P value <0.05 for all); whereas women in the lowest quartile (Q1) of the Western pattern had a higher odds for (Preterm birth), (OR 1.976 CI 95% (1.346-2.903), P value = 0.037), compared to those in the highest quartile (Q4).

Conclusion: The Asian-like pattern may be associated with a lower prevalence of preterm birth, low birth weight, and congenital anomalies, whereas the Western pattern may be associated with a higher prevalence of preterm birth.

Keywords: Dietary patterns; factor analysis; maternal obesity; Palestine; pregnancy

Abbreviations

BMI: Body Mass Index; WHO: World Health Organization; FPG: Fasting Plasma Glucose; FFQ: Food Frequency Questionnaire; IPAQ: International Physical Activity Questionnaire; LBW: Low Birth Weight; NBW: Normal Birth Weight; OR: Odds Ratio; CI: Confidence Interval; MET: Metabolic Equivalent; Q: Quartile

Introduction

Obesity has reached epidemic proportions globally, with at least 2.8 million people dying each year as a result of being overweight or obese [1]. Once associated with high-income countries, obesity is now also prevalent in low- and middle-income countries [1]. Current estimates suggest that by 2025 more than 21% of women in the world will be obese [2]. In Palestine, the prevalence of obesity among pregnant women is 18.1% (15.9% in West bank and 20.3% in Gaza strip) [3]. The highest prevalence was in North Gaza 27.3%, Deiral Balah 22.7% and Khan Younis 20.9%; the lowest prevalence was in Tubas 13.7%, Jenin 14.0% and Bethlehem 14.6% [3]. Maternal obesity is a key consideration in the provision of maternity care due to the increasing rates of women presenting with a body mass index (BMI) ≥ 30 kg/m^2 [4] and association with an increased risk of maternal co-morbidity, pregnancy-related complications and fetal morbidity and mortality [5]. Having a higher BMI at the start of a pregnancy will increase the health risks to both the mother and infant [4],[5]. There are various complications for the mother [6],[7], and there various increased risks for the infant including shoulder dystocia, birth defects, fetal and neonatal death and stillbirth [8],[9]. Some of the birth risks are related to the increase in large for gestational age babies [10]. In addition, antenatal care costs may be five to sixteen fold higher in overweight and obese women [7]. Scott-Pillai et al [11], identified that for women having a BMI at booking of between 35-40 kg/m^2 there was a six times greater risk of developing gestational diabetes, a 1.8 increased risk of requiring a caesarean section, a two

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times greater risk of the baby suffering shoulder dystocia and a 2.2 times greater risk of the baby being stillborn.

Overweight and obesity, as well as their related consequences, are largely preventable [1]. Supportive environments and communities are fundamental in shaping people's choices, by making the choice of healthier foods and regular physical activity the easiest choice (The choice that is the most accessible, available and affordable), and therefore preventing overweight and obesity [1]. Furthermore, the role of healthy eating and physical activity in the prevention of gestational diabetes and excessive weight gain must be explained to women [12]. However, there is currently little evidence to inform the content and structure of antenatal weight management or health lifestyle interventions [4],[12]. Dietary patterns are an approach that has been used to investigate diet-disease relations [13]. Dietary pattern is potentially useful in making dietary recommendations because overall dietary patterns might be easy for the public to interpret or translate into diets [14]. However, dietary patterns are population-specific and can be influenced by socio-cultural factors [15] and food availability [16].In conclusion, maternal nutrition is the main determinant of fetal development, birth weight and disease of the infant, as well as the women's health and reproductive capacity [17]. However, few studies have explored the relationship between maternal dietary patterns during early pregnancy and pregnancy outcome among pregnant obese women [18]. Most studies have examined the associations between individual foods or food groups and nutrients and pregnancy outcome [19],[20], instead of focusing on dietary patterns which is the most sensible approach to test the role of the overall diet on nutrition-related diseases. Therefore, understanding the association between maternal dietary patterns during early pregnancy with pregnancy outcome may be helpful in reducing maternal co-morbidity, pregnancy-related complications and improve pregnancy outcomes among obese women. To the best of our knowledge, this is the first study that examined this association among pregnant obese women in Gaza Strip, Palestine. This study was conducted to identify major dietary patterns during early pregnancy and their association with pregnancy outcome among obese women at maternal antenatal clinics in primary healthcare centers in Gaza Strip, Palestine.

Methods and Materials

Research design and study population

This a prospective cohort study was conducted in the years 2018 and 2019 among a representative sample of Palestinian pregnant obese women during the first trimester, selected from four various maternal antenatal clinics (Remal, Shatea, Sheikh Radwan and Sabraa clinic), by the multistage cluster random sampling method. A total of 200 pregnant obese women (BMI ≥ 30 kg/m^2), aged more than 18 years old, singleton pregnant women, who were being attended at maternal antenatal clinics in primary healthcare centers in Gaza Strip, Palestine, were included in the study. Twin pregnancies, pregnant women with pre-existing diabetes mellitus or hypertension, and pregnant women with other types of serious illness such as cancer or acute myocardial infarction were excluded from the study. All women were evaluated in two occasions, during the first trimester of pregnancy and after delivery. Sample size and sample determination: In the present study, the sample size was calculated using Epi Info Program version six [21]. Based on a previous study, the prevalence of obesity among pregnant women in Gaza Strip was 20.3% [3]. Accordingly, the study sample size was calculated, and we reached the sample size of 185 women with a confidence level of 99.9% when the worst acceptable result was 30%. To consider probable dropouts, at the end a total of 200 pregnant obese women were included in the present study.

Ethics approval and consent to participate

The study protocol was approved by the Ethics Committee of Al Azhar University of Gaza and by the Palestinian Health Research Council (Helsinki Ethical Committee). In addition, written informed consent was also obtained from each participant.

Data Collection

Assessment of anthropometric measurements

Height (m) and weight (kg) were obtained during the first visit according to standard [22]. In addition, the BMI was calculated by dividing weight in kilograms by the square of height in meters. The BMI was categorized according to the World Health Organization (WHO) standards as follows: Obesity class I; BMI: 30.0–34.9 kg/m^2, obesity class II; BMI: 35.0–39.9 kg/m^2, and obesity class III; BMI: ≥ 40 kg/m^2 [23].

Biochemical analysis

After 12 hours fasting, venous blood samples were collected from all women at the maternal antenatal clinics in primary healthcare centers (During week 24 of pregnancy), by well-trained and experienced nurses. Venous blood (4.0 ml) was drawn into vacationer tubes and was used for blood chemistry analysis. Serum was separated immediately, and the extracted serum was investigated for fasting plasma glucose (FPG) mg/dl. Mindray BS-300 chemistry analyzer instrument was used for blood chemistry analysis [24].In addition, hemoglobin level before delivery (g/dl), was measured and the results of all biochemical analysis were recorded on the women antenatal health records. The blood samples were taken using the protocol outlined in [25].

Assessment of blood pressure

The systolic and diastolic blood pressure was measured from the left arm (mmHg), by the primary healthcare centers doctors, in the morning during each visit (First visit, week 12-18, week 20-26, week 30-34, and week 36-38 of pregnancy) to maternal antenatal clinics using the calibrated mercury sphygmomanometer [26]. Women were seated after relaxing for at least fifteen minutes in a quiet environment, empty bladder. The average of the measurements was recorded on the women antenatal health records.

Assessment of dietary patterns

Data about dietary patterns was obtained using a validated semi-quantitative food frequency questionnaire (FFQ). The FFQ in our study contains a list of 98 food items; it was developed and validated among Palestinian population in 2014 [27]. All participants were asked to estimate the number of times per day, week or month he/she consumed these particular food products and the amount usually eaten per food item by making comparisons with the specified reference portion. The answer categories ranged from one to seven times including never, one to three times per month, one to two

Table 1: Food groupings used in the dietary patterns analysis.

Food Groups	Food Items
Refined grains	White breads, toasted bread, cooked white rice, pasta (macaroni, spaghetti and the like)
Whole grains	Wheat bread, corn or canned, cooked cereals (as bulgur and the like)
Potatoes	Boiled potatoes
Beans and legumes	Cooked (lentils, chickpeas, black beans or white)
Red meat	(Beef, lamb), other meat (rabbit, duck), cold meats, hamburger
Organ meat	Beef liver or chicken liver, viscera (tripe, brains and the like)
Poultry	Chicken with skin, skinless chicken
Fish and shellfish products	Mixed fried fish, boiled or grilled fish (sardines, tuna), salted fish, canned water fish, canned fish in oil, (oysters, clams, mussels and the like), shellfish (shrimp and the like)
Fast foods	Meats as mortadella, sausage, pizza, pie
Eggs	Eggs
Low-fat dairy products	Skim milk, skimmed milk powder, yogurt
High-fat dairy products	Whole milk, (condensed milk, milk powder), cottage cheese curd or fresh white cheese, cream cheese or portions, ice cream, chocolate powder and the like, chocolate
Vegetables	Cooked spinach, (cabbage, cauliflower, broccoli), lettuce, onions, (carrots, pumpkin), cooked green beans, (eggplant, zucchini, cucumbers), mushrooms, canned vegetables, cooked green peas, garlic, pepper, (parsley, thyme, bay leaves, oregano, cilantro, mint and the like), avocado
Tomatoes	Tomatoes, tomato sauce (ketchup)
Fruits	Lemons, (oranges, grapefruit and the like), bananas, apple or pear, strawberries, (peach, apricot), fresh figs, (watermelon, cantaloupe, pineapple), papaya, grapes, mango, guava, kiwi, dried fruits (as raisins, prunes), fruits in syrup (juices of fruits, peach, pear, pineapple, fig)
Hydrogenated fats	Margarine, butter, mayonnaise
Vegetable oils	Corn oil, sunflower oil
Olives	Olives, olive oil
Nuts and seed products	Nuts (almonds, peanuts, hazelnuts, walnuts and the like), tahini (sesame seeds)
Sugar, sweets, and desserts	Biscuit, (croissant, pastries), shortbread, brownie, (custard, custard pudding), (jams, honey), sugar, tasty type artificial sweeteners
Snacks	Potato chips, bag of chips
Condiments	Spicy (pepper, chili)
Soft drinks	Soft drinks with sugar (as cola, orange, lemon, fanta and the like), low calorie soft drinks, fruit juice packaging
Beverages	Coffee, decaffeinated coffee, tea
Salt and pickles	Salt, pickles

times per week, three to four times per week, five to six times per week, one time per day or two to three times per day. Dietary intakes were converted into grams per day. In addition, dietary patterns were obtained using factor analysis after the classification of food items into 25 groups [13].

Assessment of other variables

Additional information regarding demographic, socioeconomic and medical history variables was obtained with an interview-based questionnaire. Past obstetric history and any previous treatment was recorded by the primary healthcare centers doctors on the women antenatal health records. In the present study, reports and all relevant documentation, including antenatal health records were checked. Furthermore, data on physical activity was collected using the international physical activity questionnaire (IPAQ short version) [28]. Moreover, infant's birth date and weight (g) were recorded at birth. Infant's weight was categorized according to the WHO standards as follows: Low birth weight (LBW); a birth weight less than 2500 g, normal birth weight (NBW); a birth weight $\geq$ 2500 g and $\leq$ 4000 g [29]. Fetal macrosomia was defined as birth weight > 4,000 g [30], and an infant born before 37 completed weeks of gestational age as preterm birth [29]. Pilot study was carried out on twenty women to enable the researcher to examine the tools of the study. The questionnaire and data collection process were modified according to the result of the pilot study. The data was collected by ten qualified data collectors (Five nurses and five nutritionists), who were given a full explanation and training by the researcher about the study.

Statistical analysis

All statistical analysis was performed using SPSS version 20. We applied principal component analysis in order to find major dietary patterns, after classification of the 98 food items in the FFQ into 25 food groups [13]. The food grouping was based on the similarity of nutrient profiles and was somewhat similar to that used in previous studies [14],[15]. A varimax rotation was used, factor loads under 0.2 were excluded [16]. For determining the number of factors, we considered eigenvalues > 1, the scree plot, and the interpretability of the factors. The adequacy of data was evaluated based on the value of Kaiser-Meyer-Olkin and Bartlett's test. In the present study, the Kaiser-Mayer-Olkin coefficient, was calculated and the obtained value

Table 2: Characteristics of the study population by categories of obesity.

Variables		Total (n=200) No. (%)	Obesity class I (n=147) No. (%)	Obesity class II (n=33) No. (%)	Obesity class III (n=20) No. (%)	P Value
Age (years)	Mean±SD	29.9±5.8	29.6±6.0	31.1±5.7	30.5±4.8	0.409
Educational level	Low	136.0 (68.0)	102.0 (75.0)	21.0 (15.4)	13.0 (9.6)	
	High	64.0 (32.0)	45.0 (70.3)	12.0 (18.8)	7.0 (10.9)	0.778
Employment history	Housewife	180.0 (90.0)	134.0 (74.4)	27.0 (15.0)	19.0 (10.6)	
	Employed	20.0 (10.0)	13.0 (65.0)	6.0 (30.0)	1.0 (5.0)	0.199
Family size	Less than 5	106.0 (53.0)	81.0 (76.4)	18.0 (17.0)	7.0 (6.6)	
	Five or more	94.0 (47.0)	66.0 (70.2)	15.0 (16.0)	13.0 (13.8)	0.235
Monthly income	≤ 2000 (NIS)	154.0 (77.0)	114.0 (74.0)	24.0 (15.6)	16.0 (10.4)	
	> 2000 (NIS)	46.0 (23.0)	33.0 (71.7)	9.0 (19.6)	4.0 (8.7)	0.792
History of smoking	Active	2.0 (1.0)	2.0 (100.0)	0.0 (0.0)	0.0 (0.0)	
	Passive	72.0 (36.0)	53.0 (73.6)	12.0 (16.7)	7.0 (9.7)	0.945
	Non-smoker	126.0 (63.0)	92.0 (73.0)	21.0 (16.7)	13.0 (10.3)	
Family history of CVDs	Yes	25.0 (12.5)	19.0 (76.0)	3.0 (12.0)	3.0 (12.0)	
	No	175.0 (87.5)	128.0 (73.1)	30.0 (17.1)	17.0 (9.7)	0.783
Family history of hypertension	Yes	99.0 (49.5)	62.0 (62.6)	19.0 (19.2)	18.0 (18.2)	
	No	101.0 (50.5)	85.0 (84.2)	14.0 (13.9)	2.0 (2.0)	0.001
Family history of diabetes mellitus	Yes	89.0 (44.5)	60.0 (67.4)	15.0 (16.9)	14.0 (15.7)	
	No	111.0 (55.5)	87.0 (78.4)	18.0 (16.2)	6.0 (5.4)	0.048
Family history of hyperlipidemia	Yes	1.0 (0.5)	1.0 (100.0)	0.0 (0.0)	0.0 (0.0)	
	No	199.0 (99.5)	146.0 (73.4)	33.0 (16.6)	20.0 (10.1)	0.834
Family history of liver diseases	Yes	4.0 (2.0)	3.0 (75.0)	0.0 (0.0)	1.0 (25.0)	
	No	196.0 (98.0)	144.0 (73.5)	33.0 (16.8)	19.0 (9.7)	0.451
Family history of renal diseases	Yes	3.0 (1.5)	3.0 (100.0)	0.0 (0.0)	0.0 (0.0)	
	No	197.0 (98.5)	144.0 (73.1)	33.0 (16.8)	20.0 (10.2)	0.577
Physical activity (Total MET)	Mean±SD	1506.9±1516	2311.8±2167	1407.7±1314	908.2±1150	0.001
SBP First visit	Mean±SD	106.2±6.2	105.9±6.3	106.9±5.8	107.0±5.7	0.569
DBP First visit	Mean±SD	69.35±4.1	69.08±4.1	69.70±3.9	70.75±4.0	0.21
SBP in week 12-18	Mean±SD	109.6±8.8	109.4±9.9	110.0±4.6	110.7±5.4	0.8
DBP in week 12-18	Mean±SD	70.54±6.8	70.82±5.3	68.24±12.0	72.25±4.7	0.075
SBP in week 20-26	Mean±SD	113.4±8.9	112.8±8.7	112.1±5.1	119.7±12.8	0.003
DBP in week 20-26	Mean±SD	73.11±6.9	72.94±6.7	71.52±4.7	77.00±9.5	0.016
SBP in week 30-34	Mean±SD	120.3±71.6	121.5±83.3	113.7±6.9	122.0±11.9	0.849
DBP in week 30-34	Mean±SD	75.20±10.4	75.07±11.4	73.48±5.3	79.00±8.5	0.169
SBP in week 36-38	Mean±SD	114.8±11.8	114.0±12.3	115.4±9.3	120.0±10.7	0.101
DBP in week 36-38	Mean±SD	74.50±8.7	74.01±9.1	74.24±5.6	78.50±8.9	0.096

Data are expressed as means ± SD for continuous variables and as percentage for categorical variables. The differences between means were tested by using independent sample t test and One-way ANOVA. The chi-square test was used to examine differences in the prevalence of different categorical variable. P value less than 0.05 was considered as statistically significant. SD: Stander deviation; CVDs: Cardiovascular diseases; MET: Metabolic equivalents; SBP: Systolic blood pressure (mmHg); DBP: Diastolic blood pressure (mmHg).Table 4: Factor loading matrix for major dietary patterns

was 0.637. Then, the obtained dietary patterns scores are expressed as quartiles. The chi-square test was used to examine differences in the prevalence of different categorical variables. The differences between means were tested by independent sample t-test and One-way ANOVA. Finally, the odds ratio (OR) and confidence interval (CI) for the pregnancy outcome across quartiles categories of dietary patterns scores were tested by binary logistic regression. P value less than 0.05 was considered as statistically significant.

Results

Characteristics of the study population by categories of obesity

A total of 200 obese pregnant women (BMI ≥ 30kg/m^2), aged > 18 years old were included in this study. The characteristics of the

Table 3: Medical history and pregnancy outcome of the study population by categories of obesity.

		Total (n=200)	Obesity class I (n=147)	Obesity class II (n=33)	Obesity class III (n=20)	P
Variables		**No. (%)**	**No. (%)**	**No. (%)**	**No. (%)**	**Value**
Gestational age (years)	Mean±SD	35.8±3.6	36.1±2.7	34.4±6.4	35.83.2	0.072
Last menstrual period	Mean of date	22.05.2018	21.05.2018	23.05.2018	02.06.2018	0.189
Actual date of delivery	Mean of date	20.02.2019	19.02.2019	20.02.2019	23.02.2019	0.948
Gravida	Mean±SD	5.03±2.9	5.00±3.0	4.72±2.6	5.70±2.5	0.492
Para	Mean±SD	3.33±2.3	3.29±2.5	3.15±2.0	3.90±1.9	0.515
Abortion	Mean±SD	0.70±1.1	0.70±1.1	0.66±1.1	0.75±0.8	0.965
History of postpartum hemorrhage	Yes	14.0 (7.0)	10.0 (71.4)	3.0 (21.4)	1.0 (7.1)	
	No	186.0 (93.0)	137.0 (73.7)	30.0 (16.1)	19.0 (10.2)	0.838
History of antepartum hemorrhage	Yes	7.0 (3.5)	5.0 (71.4)	1.0 (14.3)	1.0 (14.3)	
	No	193.0 (96.5)	142.0 (73.6)	32.0 (16.6)	19.0 (9.8)	0.924
History of previous caesarian section	Yes	32.0 (16.0)	26.0 (81.2)	2.0 (6.2)	4.0 (12.5)	
	No	168.0 (84.0)	121.0 (72.0)	31.0 (18.5)	16.0 (9.5)	0.226
History of anemia	Yes	98.0 (49.0)	71.0 (72.4)	19.0 (19.4)	8.0 (8.2)	
	No	102.0 (51.0)	76.0 (74.5)	14.0 (13.7)	12.0 (11.8)	0.439
History of big baby	Yes	39.0 (19.5)	25.0 (64.1)	8.0 (20.5)	6.0 (15.4)	
	No	161.0 (80.5)	122.0 (75.8)	25.0 (15.5)	14.0 (8.7)	0.292
History of intrauterine growth restriction	Yes	17.0 (8.5)	12.0 (70.6)	3.0 (17.6)	2.0 (11.8)	
	No	183.0 (91.5)	135.0 (73.8)	30.0 (16.4)	18.0 (9.8)	0.954
History of congenital anomalies	Yes	9.0 (4.5)	7.0 (77.8)	0.0 (0.0)	2.0 (22.2)	
	No	191.0 (95.5)	140.0 (73.3)	33.0 (17.3)	18.0 (9.4)	0.225
History of gestational diabetes	Yes	4.0 (2.0)	3.0 (75.0)	1.0 (25.0)	0.0 (0.0)	
	No	196.0 (98.0)	144.0 (73.5)	32.0 (16.3)	20.0 (10.2)	0.745
History of gestational hypertension	Yes	24.0 (12.0)	13.0 (54.2)	5.0 (20.8)	6.0 (25.0)	
	No	176.0 (88.0)	134.0 (76.1)	28.0 (15.9)	14.0 (8.0)	0.02
Complain of edema	Yes	44.0 (22.0)	32.0 (72.7)	4.0 (9.1)	8.0 (18.2)	
	No	156.0 (78.0)	115.0 (73.7)	29.0 (18.6)	12.0 (7.7)	0.059
Fellow dietary regimen during pregnancy	Yes	5.0 (2.5)	4.0 (80.0)	1.0 (20.0)	0.0 (0.0)	
	No	195.0 (97.5)	143.0 (73.3)	32.0 (16.4)	20.0 (10.0)	0.748
	Less than 3	82.0 (41.0)	59.0 (72.0)	11.0 (13.4)	12.0 (14.6)	
Number of meals per day	Three meals	98.0 (49.0)	70.0 (71.4)	20.0 (20.4)	8.0 (8.2)	0.146
	More than 3	20.0 (10.0)	18.0 (90.0)	2.0 (10.0)	0.0 (0.0)	
Dietary supplement use	Yes	40.0 (20.0)	29.0 (72.5)	9.0 (22.5)	2.0 (5.0)	
	No	160.0 (80.0)	118.0 (73.8)	24.0 (15.0)	18.0 (11.2)	0.309
FPG during week 24 of pregnancy (mg/dl)	Mean±SD	80.81±7.9	80.42±8.4	81.57±6.3	82.45±6.8	0.474
Hemoglobin level before delivery (g/dl)	Mean±SD	11.28±4.5	11.42±5.3	10.91±0.6	10.92±0.7	0.795
	Normal vaginal	116.0 (58.0)	87.0 (75.0)	20.0 (17.2)	9.0 (7.8)	
Mode of delivery	Cesarean	53.0 (26.5)	7.0 (13.2)	8.0 (15.1)	38.0 (71.7)	0.022
	Instrumental	3.0 (1.5)	1.0 (33.3)	0.0 (0.0)	2.0 (66.7)	
	Induction prostaglandin	28.0 (14.0)	21.0 (75.0)	6.0 (21.4)	1.0 (3.6)	
	Elevation of BP	12.0 (6.0)	8.0 (66.7)	3.0 (25.0)	1.0 (8.3)	
Mother complications after delivery	Hemorrhage	14.0 (7.0)	9.0 (64.3)	3.0 (21.4)	2.0 (14.3)	0.844
	Puerperal sepsis	5.0 (2.5)	4.0 (80.0)	0.0 (0.0)	1.0 (20.0)	
	No complication	169.0 (84.5)	126.0 (74.6)	27.0 (16.0)	16.0 (9.5)	

Pregnancy outcome						
Duration of pregnancy	Preterm birth	5.0 (2.5)	2.0 (40.0)	1.0 (20.0)	2.0 (40.0)	
	Full-term birth	195.0 (97.5)	145.0 (74.4)	32.0 (16.4)	18.0 (9.2)	0.066
Mother complications after delivery	Yes	31.0 (15.5)	21.0 (67.7)	6.0 (19.4)	4.0 (12.9)	
	No	169.0 (84.5)	126.0 (74.6)	27.0 (16.0)	16.0 (9.5)	0.72
Baby outcome	Dead	1.0 (0.5)	0.0 (0.0)	0.0 (0.0)	1.0 (100.0)	
	Live	199.0 (99.5)	147.0 (73.9)	33.0 (16.6)	19.0 (9.5)	0.011
	LBW	6.0 (3.0)	5.0 (83.3)	1.0 (16.7)	0.0 (0.0)	
Baby birth weight	NBW	162.0 (81.0)	123.0 (75.9)	23.0 (14.2)	16.0 (9.9)	0.285
	Macrosomia	32.0 (16.0)	19.0 (59.4)	9.0 (28.1)	4.0 (12.5)	
Newborn delivery trauma	Yes	1.0 (0.5)	1.0 (100.0)	0.0 (0.0)	0.0 (0.0)	
	No	199.0 (99.5)	146.0 (73.4)	33.0 (16.6)	20.0 (10.1)	0.834
Admission to Neonate Department	Yes	7.0 (3.5)	4.0 (57.1)	2.0 (28.6)	1.0 (14.3)	
	No	193.0 (96.5)	143.0 (74.1)	31.0 (16.1)	19.0 (9.8)	0.595
Congenital anomalies	Yes	2.0 (1.0)	2.0 (100.0)	0.0 (0.0)	0.0 (0.0)	
	No	198.0 (99.0)	145.0 (73.2)	33.3 (16.7)	20.0 (10.1)	0.695
Congenital heart defect	Yes	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	-
	No	200.0 (100.0)	147.0 (73.5)	33.0 (16.5)	20.0 (10.0)	
Cyanosis	Yes	4.0 (2.0)	2.0 (50.0)	1.0 (25.0)	1.0 (25.0)	
	No	196.0 (98.0)	145.0 (74.0)	32.0 (16.3)	19.0 (9.7)	0.496
Jaundice	Yes	2.0 (1.0)	0.0 (0.0)	2.0 (100.0)	0.0 (0.0)	
	No	198.0 (99.0)	147.0 (74.2)	31.0 (15.7)	20.0 (10.1)	0.006

study population by categories of obesity is shown in Table 2. The results revealed that the mean age (years) for women with obesity class I, women with obesity class II, and women with obesity class III was 29.6±6.0, 31.1±5.7, and 30.5±4.8 respectively. In addition, for the following factors (Family history of hypertension, family history of diabetes mellitus, physical activity level (Total MET), systolic and diastolic blood pressure in the week 20 to 26 of pregnancy), the difference was statistically significant across categories of obesity (P value < 0.05).

Medical history and pregnancy outcome of the study population by categories of obesity

On the other hand, the medical history and pregnancy outcome of the study population by categories of obesity is shown in Table 3. The results of this study demonstrate that the mean gestational age (years) for the study population was 35.8±3.6, the mean date for the last menstrual period was May 22, 2018, and the mean date for the actual date of delivery was February 20, 2019. In addition, the mean Gravida for the study population was 5.03±2.9, the mean para was 3.33±2.3, and the mean abortion was 0.70±1.1. Furthermore, the mean FPG level (mg/dl) during week 24 of pregnancy was 80.81±7.9, and the mean hemoglobin level (g/dl) before delivery was 11.28±4.5. Moreover, Table 3 shows that 7.0% of the women had history of postpartum hemorrhage, 3.5% had history of antepartum hemorrhage, 16.0% had history of previous caesarian section, 49.0% had history of anemia, 19.5% had history of big baby, 8.5% had history of intrauterine growth restriction, 4.5% had history of congenital anomalies, 2.0% had history of gestational diabetes, 12.0% had history of gestational hypertension, 22.0% of the women complaining of edema, 2.5% fellow dietary regimen duringpregnancy, 41.0% had less than three meals per day, 20.0% of the women use a dietary supplements during pregnancy, and 58.0% of the women had normal vaginal delivery. With respect to pregnancy outcome, Table 3 shows that 2.5% of the women had preterm birth, 15.5% had complications after delivery, 0.5% had dead baby, 3.0% had a newborn with LBW, 0.5% had a newborn with delivery trauma, 3.5% of the babies were admitted to neonate department, 1.0% of the women had a newborn with congenital anomalies, 2.0% had a newborn with cyanosis, and 1.0% had a newborn with jaundice. Additionally, for the following factors (History of gestational hypertension, mode of delivery, baby outcome, and jaundice), the difference was statistically significant across categories of obesity (P value < 0.05).

Factor loading matrix for major dietary patterns

Then, we entered food consumption data for the 25 food groups (Table 1) into the SPSS for factor analysis. The scree plot of eigenvalues indicated two major patterns: 1. Asian-like pattern characterized by a high intake of whole grains, potatoes, beans and legumes, fish and shellfish products, low-fat dairy products, vegetables, tomatoes, fruits, vegetables oils, olives, nuts and seed products. 2. Western pattern characterized by a high intake of refined grains, red meat, organ meat, poultry, fast foods, eggs, high-fat dairy products, hydrogenated fats, sugar, sweets, and desserts, snacks, condiments, soft drinks, beverages, salt and pickles. 3. The factor loading matrixes for the two major patterns are shown in Table 4. These two major dietary patterns explained 12.4% and 23.3% of the total variance, respectively. In our study, the dietary patterns scores were classified as quartiles.

Table 4: Factor loading matrix for major dietary patterns.

	Dietary patterns	
Food Groups	**Asian-like pattern**	**Western pattern**
Refined grains	-	0.645
Whole grains	0.307	-
Potatoes	0.235	-
Beans and legumes	0.412	-
Red meat	-	0.598
Organ meat	-	0.265
Poultry	-	0.326
Fish and shellfish products	0.251	-
Fast foods	-	0.443
Eggs	-	0.485
Low-fat dairy products	0.313	-
High-fat dairy products	-	0.542
Vegetables	0.638	-
Tomatoes	0.453	-
Fruits	0.681	-
Hydrogenated fats	-	0.423
Vegetables oils	0.668	-
Olives	0.305	-
Nuts and seed products	0.205	-
Sugar, sweets, and desserts	-	0.335
Snacks	-	0.492
Condiments	-	0.49
Soft drinks	-	0.518
Beverages	-	0.389
Salt and pickles	-	0.546
Variance explained (%)	12.43	23.373

Values less than 0.2 were omitted for simplicity. Total variance explained by two factors: 35.803

Characteristics and medical history of the study population by Quartiles (Q) categories of dietary patterns scores

Then, the characteristics and medical history of the study population were evaluated within the quartiles. Table 5 shows that, women in the lowest quartile (Q1) of the Asian-like pattern had a lower Gravida (4.2±2.3 vs. 5.5±3.3, P value = 0.039) compared to those in the highest quartile (Q4). In addition, women in the lowest quartile (Q1) of the Western pattern had a lower family history of liver diseases (16.7 vs. 33.3 %, P value = 0.015), and had a lower history of congenital anomalies (0.0 vs. 66.7 %, P value = 0.026), compared to those in the highest quartile (Q4). Furthermore, they had better glucose and blood pressure control. Moreover, the distribution of women with regard to family history of liver diseases, and history of congenital anomalies was significantly different across the quartiles of the Western pattern (P value < 0.05 for all). On the other hand, only the distribution of women with regard to Gravida was significantly different across the quartiles of the Asian-like pattern (P value < 0.05).

Odd ratio and confidence interval for pregnancy outcome across quartiles categories of dietary patterns scores

Finally, we computed the OR and CI for the pregnancy outcome across quartiles categories of dietary patterns scores (Table 2- 6). Our findings demonstrate that, after adjustment for confounding variables, women in the lowest quartile (Q1) of the Asian-like pattern characterized by a high intake of whole grains, potatoes, beans and legumes, fish and shellfish products, low-fat dairy products, vegetables, tomatoes, fruits, vegetables oils, olives, nuts and seed products had a lower odds for (Preterm birth, LBW, and congenital anomalies), (OR 0.368 CI 95% (0.187-0.726)), (OR 0.308 CI 95% (0.133-0.714)), and (OR 0.394 CI 95% (0.197-0.791)) respectively, (P value <0.05 for all); whereas women in the lowest quartile (Q1) of the Western pattern characterized by a high intake of refined grains, red meat, organ meat, poultry, fast foods, eggs, high-fat dairy products, hydrogenated fats, sugar, sweets, and desserts, snacks, condiments, soft drinks, beverages, salt and pickles had a higher odds for (Preterm birth), (OR 1.976 CI 95% (1.346-2.903), P value = 0.037), compared to those in the highest quartile (Q4). Additionally, no significant association was found between the two major dietary patterns with mother complications after delivery, baby outcome (Dead), newborn delivery trauma, admission to neonate department, cyanosis, and jaundice.

Discussion

Maternal nutritional status during pregnancy is the main determinant of fetal development, birth weight and disease of the infant, as well as the women's health and reproductive capacity [17]. To the best of our knowledge, this is the first study which describes the dietary patterns during early pregnancy and their association with pregnancy outcome among obese women at maternal antenatal clinics in primary healthcare centers in Gaza Strip, Palestine. In the present study, with the use of dietary data from the 98-items semi-quantitative FFQ, two major dietary patterns were identified by factor analysis.

1) Asian-like pattern characterized by a high intake of whole grains, potatoes, beans and legumes, fish and shellfish products, low-fat dairy products, vegetables, tomatoes, fruits, vegetables oils, olives, nuts and seed products.

2) Western pattern characterized by a high intake of refined grains, red meat, organ meat, poultry, fast foods, eggs, high-fat dairy products, hydrogenated fats, sugar, sweets, and desserts, snacks, condiments, soft drinks, beverages, salt and pickles.

The main findings of this study indicate that, after adjustment for confounding variables, the Asian-like pattern may be associated with a lower prevalence of preterm birth, LBW, and congenital anomalies; whereas the Western pattern may be associated with a higher prevalence of preterm birth among pregnant obese women in Gaza Strip, Palestine.

In fact, few studies have explored the relationship between maternal dietary patterns during early pregnancy and pregnancy outcome among pregnant obese women [18]. Most studies have examined the associations between individual foods or food groups and nutrients and pregnancy outcome [19],[20], instead of focusing on dietary patterns which is the most sensible approach to test the

Table 5: Characteristics and medical history of the study population by Quartiles (Q) categories of dietary patterns scores.

Variables	Asian-like pattern				P	Western pattern				P
	Q1	Q2	Q3	Q4	Value	Q1	Q2	Q3	Q4	Value
Age (years)										
Mean±SD	30.8±5.6	29.8±5.8	30.5±4.9	29.2±6.9	0.169	30.5±5.1	30.8±5.4	28.8±5.8	30.4±6.8	0.707
Educational level %										
Low educated	17.6	25.7	25	31.7		19.8	25.6	28.4	26.2	
High educated	40.6	23.4	25	11	0.114	37.3	23.7	17	22	0.576
Employment history %										
Housewife	22.8	26.1	23.9	27.2		22.2	24.4	27.2	26.2	
Employed	45	15	35	5	0.938	45.8	29.2	8.3	16.7	0.813
Family size %										
Less than five	28.3	23.6	22.6	25.5		25.2	21.5	29	24.3	
Five or more	21.2	26.6	27.7	24.5	0.64	24.7	29	20.4	25.9	0.732
Monthly income (NIS) %										
≤ 2000 (NIS)	19.5	29.2	22.1	29.2		20.1	25.5	26.8	27.6	
> 2000 (NIS)	43.5	10.9	34.7	10.9	0.517	39.3	23.5	19.6	17.6	0.255
History of smoking %										
Non-smoker	28.6	25.4	27	19	0.389	23.8	24.6	24.6	27	0.422
Family history of cardiovascular diseases %										
Yes	40	32	20	8	0.399	35	25	15	25	0.061
Family history of hypertension %										
Yes	25.2	29.3	20.2	25.3	0.644	17.5	29.9	23.7	28.9	0.117
Family history of diabetes mellitus %										
Yes	27	25.8	20.2	27	0.465	19.1	27	24.7	29.2	0.629
Family history of hyperlipidemia %										
Yes	0	0	0	100	0.323	0	0	0	100	0.718
Family history of liver diseases %										
Yes	25	25	25	25	0.177	16.7	33.3	16.7	33.3	0.015
Family history of renal diseases %										
Yes	0	0	66.7	33.3	0.373	40	40	0	20	0.391
Physical activity (Total MET)										
Mean±SD	1377.2±1647	1702.3±1503	1452.8±1398	1495.5±1533	0.241	1217.4±1210	1329.5±1075	1310.7±1216	1750.8±1812	0.332
Systolic blood pressure in week 20-26 (mmHg)										
Mean±SD	110.8±7	113.5±7	114.3±9	115.2±10	0.237	111.1±8	112.5±7	114.9±10	114.0±9	0.919
Diastolic blood pressure in week 20-26 (mmHg)										
Mean±SD	70.0±6.4	73.4±5.5	74.0±7.1	75.0±7.5	0.092	71.2±6.8	72.7±5.8	74.6±7.6	72.7±7.4	0.352
Gestational age (years)										
Mean±SD	35.5±2.6	36.6±2.5	34.9±5.6	36.1±2.9	0.502	36.1±2.9	36.2±2.9	35.2±5.6	35.6±2.7	0.238
Gravida										
Mean±SD	4.2±2.3	5.1±2.7	5.2±2.9	5.5±3.3	0.039	4.5±2.4	5.3±2.7	5.2±3.0	5.2±3.1	0.758
Para										
Mean±SD	2.7±2.1	3.5±2.3	3.6±2.2	3.5±2.7	0.334	3.0±2.2	3.6±2.2	3.3±2.4	3.4±2.7	0.282
Abortion										
Mean±SD	0.4±0.6	0.6±1.0	0.8±1.1	1.0±1.3	0.362	0.4±0.6	0.6±1.0	0.8±1.3	0.6±1.0	0.349
History of postpartum hemorrhage %										

Yes	7.1	28.6	42.9	21.4	0.471	14.3	28.6	35.7	21.4	0.308
History of antepartum hemorrhage %										
Yes	14.3	42.8	28.6	14.3	0.306	20	20	40	20	0.592
History of previous caesarian section %										
Yes	28.1	25	31.3	15.6	0.812	29.7	33.3	33.3	3.7	0.262
History of anemia %										
Yes	20.4	27.6	26.5	25.5	0.773	19.8	26	25	29.2	0.058
History of big baby %										
Yes	17.9	17.9	30.9	33.3	0.433	23.1	23.1	23.1	30.7	0.268
History of intrauterine growth restriction %										
Yes	17.6	17.6	35.3	29.5	0.287	30.4	30.4	30.4	8.8	0.561
History of congenital anomalies %										
Yes	14.3	0	57.1	28.6	0.722	0	22.2	11.1	66.7	0.026
History of gestational diabetes %										
Yes	0	25	50	25	0.452	0	33.3	33.3	33.4	0.71
History of gestational hypertension %										
Yes	20.8	33.3	29.2	16.7	0.707	16	36	28	20	0.924
Complain of edema %										
Yes	11.4	13.6	25	50	0.145	19.1	14.9	29.8	36.2	0.565
Fellow dietary regimen during pregnancy %										
Yes	0	0	40	60	0.367	14.3	28.6	42.8	14.3	0.901
Number of meals per day %										
Less than 3	24.3	23.2	23.2	29.3		21.6	27.3	26.1	25	
≥ Three meals	25.4	26.3	26.3	22	0.554	27.7	23.2	24.1	25	0.319
Dietary supplement use %										
Yes	25	15	22.5	37.5	0.058	22.5	17.5	35	25	0.865
Fasting plasma glucose during week 24 of pregnancy (mg/dl)										
Mean±SD	80.3±12	80.0±5.3	82.3±7.3	80.5±5.1	0.817	80.5±5.6	81.7±6.5	80.9±5.5	81.4±12	0.06
Hemoglobin level before delivery (g/dl)										
Mean±SD	10.9±0.7	10.9±0.8	11.0±0.7	12.2±9.0	0.6	11.0±0.8	10.9±0.8	12.1±9.0	10.9±0.7	0.712
Mode of delivery %										
Normal vaginal	24.1	25.9	22.4	27.6	0.703	22.4	23.3	25.9	28.4	0.057

ANOVA test was used for quantitative variables and chi-square for qualitative variables. P value less than 0.05 was considered as statistically significant. SD: Stander deviation.

role of the overall diet on nutrition-related diseases. Chia et al. [31], in a systematic review and meta-analysis of observational studies including 167,507 participants during pregnancy, the author concluded that adherence to healthy dietary patterns characterized by high intake of vegetables, fruits, whole grains, low-fat dairy, and lean protein foods was significantly associated with lower risk of preterm birth and a weak trend towards lower risk of LBW. On the other hand, unhealthy dietary patterns characterized by high intake of refined grains, processed meat, foods high in saturated fat and sugar were associated with lower birth weight and a trend towards higher risk of preterm birth. The results of our study support these findings. In addition, Englund-Ogge et al. [32], show that higher adherence to the traditional pattern in Norway (Potatoes and fish) was associated with lower risk of preterm birth. Furthermore, the vegetarian pattern in England (Meat substitutes, pulses, nuts, and herbal tea) was associated with lower infant birth weight, whereas the protein-rich pattern (Dairy desserts, low fat meat, and processed meats) [33], Prudent pattern (Dairy products, fruits, cracker, and meat) [34], and the eggs, starchy vegetables, fruits, and non-whole grains pattern in the United States [35], fruits, nuts, and Cantonese desserts and varied patterns in China (compared with the traditional Cantonese pattern-cereals, eggs, and Cantonese soups) [36] were associated with higher birth weight. The previous dietary patterns are different from those obtained in our study. This can be explained by demographic, cultural and ethnic differences. The causes of preterm birth are multifactorial; many of the mechanisms are associated with increased inflammation [37,38]. In our study, the inverse association between Asian-like pattern with risk of preterm birth could be attributed to pattern's healthy

Table 6: Odd ratio and confidence interval for pregnancy outcome across quartiles categories of dietary patterns scores.

Asian-like pattern						Western pattern					
Q1	Q2	Q3	Q4	P value	OR (95%CI)	Q1	Q2	Q3	Q4	P value	OR (95%CI)
Duration of pregnancy (Preterm birth) 2.5%											
40	40	0	20	0.856	1.084 (0.454-2.590)	20	0	20	60	0.361	0.688 (0.308-1.535)
Adjusted*				0.02	0.368 (0.187-0.726)	Adjusted*				0.037	1.976 (1.346-2.903)
Mother have complications after delivery (Yes) 15.5%											
19.3	9.7	32.3	38.7	0.579	1.113 (0.763-1.623)	12.9	16.1	25.8	45.2	0.108	0.737 (0.508-1.070)
Adjusted*				0.429	0.556 (0.130-2.377)	Adjusted*				0.677	1.126 (0.644-1.970)
Baby outcome (Dead) 0.5%											
0	0	100	0	0.167	0.319 (0.063-1.610)	0	0	0	100	0.307	0.273 (0.023-3.295)
Adjusted*				0.651	1.147 (0.633-2.079)	Adjusted*				0.941	0.949 (0.235-3.833)
Baby birth weight (Low birth weight) 3.0%											
33.3	33.3	16.7	16.7	0.708	1.176 (0.503-2.754)	0	50	33.3	16.7	0.377	0.696 (0.311-1.556)
Adjusted*				0.006	0.308 (0.133-0.714)	Adjusted*				0.527	1.327 (0.552-3.191)
Newborn have delivery trauma (Yes) 0.5%											
0	100	0	0	0.211	0.337 (0.061-1.850)	100	0	0	0	0.865	0.973 (0.707-1.338)
Adjusted*				0.739	1.437 (0.171-12.103)	Adjusted*				0.464	0.702 (0.273-1.809)
Admission to Neonate Department (Yes) 3.5%											
14.3	14.3	28.6	42.8	0.358	1.383 (0.693-2.759)	14.2	28.6	28.6	28.6	0.393	1.144 (0.840-1.559)
Adjusted*				0.783	1.047 (0.754-1.453)	Adjusted*				0.455	1.332 (0.628-2.825)
Congenital anomalies (Yes) 1.0%											
100	0	0	0	0.434	0.569 (0.138-2.341)	50	50	0	0	0.916	0.929 (0.236-3.652)
Adjusted*				0.046	0.394 (0.197-0.791)	Adjusted*				0.43	1.180 (0.782-1.779)
Cyanosis (Yes) 2.0%											
25	25	25	25	0.918	1.053 (0.395-2.803)	25	25	50	0	0.023	0.277 (0.107-0.717)
Adjusted*				0.875	1.086 (0.386-3.055)	Adjusted*				0.744	1.077 (0.689-1.683)
Jaundice (Yes) 1.0%											
50	0	0	50	0.799	1.188 (0.315-4.478)	50	50	0	0	0.346	0.571 (0.178-1.830)
Adjusted*				0.112	0.683 (0.427-1.092)	Adjusted*				0.832	1.163 (0.289-4.681)

The odds ratio (OR) and confidence interval (CI) for pregnancy outcome across quartiles categories of dietary patterns scores were tested by binary logistic regression. *Adjusted for family history of liver diseases, Gravida, and history of congenital anomalies. P value less than 0.05 was considered as statistically significant.

ingredients including vitamins, and antioxidants; these nutrients have been independently associated with reduced risk of preterm birth [39]. In addition, anti-inflammatory and antioxidant effects in these foods may have beneficial effects in alleviating inflammation and oxidative stress, thus have the potential to reduce inflammation contributing to premature rupture of membranes that subsequently reduce risk of preterm birth [38],[40]. Moreover, vegetables, legumes and fruits contain minerals, polyphenols and other phytochemicals that combat oxidative stress and inflammation [41]. In our study, the Asian-like pattern has been shown to be the healthiest dietary pattern and is quite close to that diet, which is generally recommended as a healthy dietary pattern with low animal foods, saturated fat, trans fat, cholesterol, and simple sugar, which may be associated with a higher risks preterm birth [42]. On the contrary, the findings of our study revealed that the Western pattern might be associated with a higher prevalence of preterm birth. Foods from Western pattern contains processed meats, foods high in saturated and hydrogenated fats, sugar and salt are associated with inflammation and preterm birth [43].

With respect to birth size, our findings revealed that the Asian-like pattern might be associated with a lower prevalence of LBW. Chen et al. [42], show that a greater adherence to healthy dietary patterns was significantly associated with higher birth weight. In contrast, unhealthy dietary patterns were associated with lower birth weight. Birth weight is influenced both by duration of gestation and rate of fetal growth [44]. In our study, the Asian-like pattern was associated with preterm birth, thus we recognize that the association between the Asian-like pattern and birth weight could be mediated by gestational age.

Additionally, our results demonstrate that the Asian-like pattern might be associated with a lower prevalence of congenital anomalies. The etiology of most congenital anomalies remains unknown [45]. Previous studies have indicated that the occurrence of congenital anomalies results from the interactions of genetic, environmental, lifestyle and nutritional factors [46]. Most of the previous studies were consistent in demonstrating that folic acid supplementation periconceptionally was associated with a decreased risk of risk of developing congenital anomalies, and it should be noted that some of the included studies were conducted in countries with mandatory folate fortification, while others were from countries that prohibit such fortification [47]. Sotres-Alvarez et al. [48], in a case-control study show that, women who adhered to a Western dietary patern characterized by a high intake of frankfurters, bacon, French fries, white bread, potato chips, and regular soda as well as a low intake of fruits and vegetables were 1.2 times more likely to have an infant with septal heart defect than were women who adhered to a Prudent diet. In addition, a Prudent dietary pattern characterized by a high intake of healthy foods such as yogurt, reduced-fat milk, whole-wheat bread, fortified cereal, and fish, even with folate fortification, may decrease the risk of neural tube defects and some heart defects [48]. The results of our study support these findings. Actually, the relationship between dietary patterns with pregnancy outcome need more studies in the future. Additionally, it is worth noting that our study not adjusted for other confounding variables such as genetics factors, and psychological factors, which could contribute to these results.

The main limitations of this study is its small sample size and the possibility of recall bias and misreporting by using FFQ assessment of dietary patterns are other limitations. Furthermore, unfortunately we do not have measures of serum micronutrients concentrations. The main strength of our study was its being the first study, which shows the dietary patterns during early pregnancy and their association with pregnancy outcome among obese women in Gaza Strip, Palestine.

Finally, we conclude that the Asian-like pattern may be associated with a lower prevalence of preterm birth, LBW, and congenital anomalies, whereas the Western pattern may be associated with a higher prevalence of preterm birth among obese women in Gaza Strip, Palestine. Further future studies are required to confirm these findings.

References

1. World Health Organization. ‘10 facts on obesity. 2019.
2. NCD Risk Factor Collaboration. ‘Worldwide trends in diabetes since a pooled analysis of 751 population-based studies with 4.4 million participants’. Lancet 2016; 387: 1513–30.
3. Ministry of Health. ‘Health Annual Report, Palestine. 2017.
4. Smith DM, Cooke A, and Lavender T. ‘Maternal obesity is the new challenge; a qualitative study of health professionals’ views towards suitable care for pregnant women with a Body Mass Index (BMI) ≥ 30 kg/m 2. BMC pregnancy and childbirth’. 2012; 12: 157.
5. Jelin AC, Sharshiner R and Caughey AB. ‘Maternal co-morbidities and neonatal outcomes associated with cystic fibrosis’. The Journal of Maternal-Fetal& Neonatal Medicine. 2017;30:4-7.
6. Catalano PM. ‘Management of obesity in pregnancy. Obstetrics &gynecology’. 20071;109:419-33.
7. Heslehurst N, Lang R, Rankin J, Wilkinson JR, andSummerbell CD. ‘Obesity in pregnancy: a study of the impact of maternal obesity on NHS maternity services’. BJOG: An International Journal of Obstetrics & Gynaecology. 2007;114:334-42.
8. Benedetti TJ, and Gabbe SG. ‘Shoulder dystocia, a complication of fetal macrosomia and prolonged second stage of labor with midpelvic delivery. Obstetrics and Gynecology’. 1978;52:526-9.
9. Robinson H, Tkatch S, Mayes DC, Bott N and Okun N. ‘Is maternal obesity a predictor of shoulder dystocia? Obstetrics &Gynecology. 2003;101:24-7.
10. Sebire NJ, Jolly M, Harris JP, Wadsworth J, Joffe M, Beard RW, et al. ‘Maternal obesity and pregnancy outcome: a study of 287 213 pregnancies in London’. International journal of obesity. 2001;25(8):1175.
11. Scott-Pillai RA, Spence D, Cardwell CR, Hunter A and Holmes VA. ‘The impact of body mass index on maternal and neonatal outcomes: a retrospective study in a UK obstetric population,BJOG: An International Journal of Obstetrics & Gynaecology. 2013;120:932-9.
12. Simmons D, Devlieger R, van Assche A, Galjaard S, Corcoy R, Adelantado J, et al. ‘Association between gestational weight gain, gestational diabetes risk, and obstetric outcomes: A randomized controlled trial post hoc analysis’. Nutrients. 2018;10:1568.
13. El Bilbeisi AH, Hosseini S and Djafarian K. ‘Association of dietary patterns with diabetes complications among type 2 diabetes patients in Gaza Strip, Palestine: a cross sectional study’. Journal of Health, Population and Nutrition. 2017;36:37.
14. El Bilbeisi AH, Hosseini S and Djafarian K. ‘Dietary patterns and metabolic syndrome among type 2 diabetes patients in Gaza Strip, Palestine’. Ethiopian journal of health sciences. 2017;27:227-38.
15. El Bilbeisi AH, Hosseini S and Djafarian K. ‘Dietary Patterns and Their Association with Blood Pressure Control among Hypertensive Patients in Gaza Strip, Palestine’. Journal of Family Medicine and Health Care. 2018;4:5-12.
16. El Bilbeisi AH, Albelbeisi A, Hosseini S and Djafarian K. ‘Dietary Pattern and Their Association with Level of Asthma Control Among Patients With Asthma at Al-Shifa Medical Complex in Gaza Strip, Palestine’. Nutrition and metabolic insights. 2019;12:1178638819841394.
17. Paknahad Z, Fallah A and Moravejolahkami AR. ‘Maternal Dietary Patterns and Their Association with Pregnancy Outcomes. Clinical nutrition research’. 2019;8:64-73.
18. Hajianfar H, Esmaillzadeh A, Feizi A, Shahshahan Z and Azadbakht L. ‘Major maternal dietary patterns during early pregnancy and their association with neonatal anthropometric measurement’. BioMed research international. 2018.
19. Rogne T, Tielemans MJ, Chong MF, YajnikCS, Krishnaveni GV, Poston L, et al. ‘Maternal vitamin B12 in pregnancy and risk of preterm birth and low birth weight: A systematic review and individual participant data meta-analysis’. American journal of epidemiology. 2017;185(3):212.
20. Van Den Broek N, Dou L, Othman M, Neilson JP, Gates S and Gülmezoglu AM. ‘Vitamin A supplementation during pregnancy for maternal and newborn outcomes’. Cochrane Database of Systematic Reviews. 2010-2011.
21. Dean AG. ‘Epi Info, version 6: a word-processing, database, and statistics program for public health on IBM-compatible microcomputers’. 1996.
22. Farag HA, Hosseinzadeh-Attar MJ, Muhammad BA, Esmaillzadeh A and El Bilbeisi AH. ‘Comparative effects of vitamin D and vitamin C supplementations with and without endurance physical activity on metabolic syndrome patients: a randomized controlled trial’. Diabetology& metabolic syndrome. 2018;10(1):80.
23. Keke LM, Samouda H, Jacobs J, Di Pompeo C, Lemdani M, Hubert H, et al. ‘Body mass index and childhood obesity classification systems: A comparison of the French, International Obesity Task Force (IOTF) and World Health Organization (WHO) references’. Revue d’epidemiologieet de santepublique. 2015;63(3):173-82.
24. El Bilbeisi AH, Hosseini S and Djafarian K. ‘Prevalence of Metabolic Syndrome and Its Components Using Two Proposed Criteria among Patients with Type 2 Diabetes in Gaza Strip, Palestine’. BAOJ Nutrition. 2018;4:054.
25. Bull SM. ‘Evidence-based blood conservation education for ICU nurses: a pre and post-test evaluation of nursing knowledge’. 2014.
26. Farag HA, Hosseinzadeh-Attar MJ, Muhammad BA, Esmaillzadeh A and El Bilbeisi AH. ‘Effects of vitamin C supplementation with and without endurance physical activity on components of metabolic syndrome: A randomized, double-blind, placebo-controlled clinical trial’. Clinical Nutrition Experimental. 2019.
27. El Bilbeisi AH,Srour M, el Afifi A, Farag HA and Djafarian K. ‘Dietary Patterns

and Their Association with Depression among Type 2 Diabetes Patients in Gaza Strip, Palestine'. Food and Nutrition. 2019;10:533-50.

28. El Bilbeisi AH, Hosseini S and Djafarian K. 'The association between physical activity and the metabolic syndrome among type 2 diabetes patients in Gaza strip, Palestine'. Ethiopian journal of health sciences. 2017;27:273-82.

29. Golestan M, AkhavanKarbasi S and Fallah R. 'Prevalence and risk factors for low birth weight in Yazd, Iran'. Singapore medical journal. 2011;52:730-3.

30. Langer O, Berkus MD, Huff RW and Samueloff A. 'Shoulder dystocia: Should the fetus weighing≥ 4000 grams be delivered by cesarean section?'. American journal of obstetrics and gynecology. 1991;165:831-7.

31. Chia AR, Chen LW, Lai JS, Wong CH, Neelakantan N, van Dam RM, et al. 'Maternal Dietary Patterns and Birth Outcomes: A Systematic Review and Meta-Analysis'. Advances in Nutrition. 2019.

32. Englund-Ögge L, Brantsæter AL, Sengpiel V, Haugen M, Birgisdottir BE, Myhre R, et al. 'Maternal dietary patterns and preterm delivery: results from large prospective cohort study'. Bmj. 2014;348:1446.

33. Northstone K, Ness AR, Emmett PM and Rogers IS. 'Adjusting for energy intake in dietary pattern investigations using principal components analysis'. European journal of clinical nutrition. 2008 ;62:931.

34. Coelho ND, Cunha DB, saudepublica. Esteves AP, Lacerda EM and Theme Filha MM. 'Dietary patterns in pregnancy and birth weight'.Revista de 2015; 49:62.

35. Starling AP, Sauder KA, Kaar JL, Shapiro AL, Siega-Riz AM, Dabelea D. 'Maternal dietary patterns during pregnancy are associated with newborn body composition'. The Journal of nutrition. 2017;147:1334-9.

36. Lu MS, Chen QZ, He JR, Wei XL, Lu JH, Li SH, et al. 'Maternal dietary patterns and fetal growth: a large prospective cohort study in China'. Nutrients. 2016;8:257.

37. Lannon SM, Vanderhoeven JP, Eschenbach DA, Gravett MG and Waldorf KM. 'Synergy and interactions among biological pathways leading to preterm premature rupture of membranes'. Reproductive Sciences. 2014;21:1215-27.

38. Menon R. 'Spontaneous preterm birth, a clinical dilemma: etiologic, pathophysiologic and genetic heterogeneities and racial disparity'. Acta obstetricia et gynecologica Scandinavica. 2008;87:590-600.

39. Akbari Z, Mansourian M and Kelishadi R. 'Relationship of the intake of different food groups by pregnant mothers with the birth weight and gestational age: Need for public and individual educational programs'. Journal of education and health promotion. 2015;4.

40. Hu Y, Huang K, Sun Y, Wang J, Xu Y, Yan S, et al. 'Placenta response of inflammation and oxidative stress in low-risk term childbirth: the implication of delivery mode'. BMC pregnancy and childbirth. 2017;17:407.

41. Rahal A, Mahima AK, Verma AK, Kumar A, Tiwari R, Kapoor S, et al. 'Phytonutrients and nutraceuticals in vegetables and their multi-dimensional medicinal and health benefits for humans and their companion animals: A review'. J. Biol. Sci. 2014;14:1-9.

42. Chen X, Zhao D, Mao X, Xia Y, Baker P, Zhang H. 'Maternal dietary patterns and pregnancy outcome'. Nutrients. 2016;8:351.

43. Myles IA. 'Fast food fever: reviewing the impacts of the Western diet on immunity'. Nutrition journal. 2014;13:1-7.

44. Klebanoff MA andYip R. 'Influence of maternal birth weight on rate of fetal growth and duration of gestation'. The Journal of pediatrics. 1987;111:287-92.

45. AbouEl-Ella SS, Tawfik MA, El-Fotoh WM and Elbadawi MA. 'Study of congenital malformations in infants and children in Menoufia governorate, Egypt'. Egyptian Journal of Medical Human Genetics. 2018;19:359-65.

46. Brent RL. 'Environmental causes of human congenital malformations: the pediatrician's role in dealing with these complex clinical problems caused by a multiplicity of environmental and genetic factors'. Pediatrics. 2004; 113:957-68.

47. McGuire S. 'US department of agriculture and US department of health and human services, dietary guidelines for americans. Washington, DC: US government printing office. 2011.

48. Sotres-Alvarez D, Siega-Riz AM, Herring AH, Carmichael SL, Feldkamp ML, Hobbs CA, et al. 'National Birth Defects Prevention Study, maternal dietary patterns are associated with risk of neural tube and congenital heart defects'. American journal of epidemiology. 2013;177:1279-88.