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Influence of Weight Gain during Pregnancy on the Risk of Cesarean Delivery of Pregnant women attending Benghazi Medical Centre

Faiza Nouh*, Salima Alfagi, Ashmisa Altuhami, Amani Suliman, Aya Alsaadi, Tasnim Faraj

Nutrition Department, Faculty of Public Health, University of Benghazi, Benghazi, Libya

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***Corresponding author:** Faiza Nouh

Abstract | **Original Research Article**

The incidence of caesarean delivery as well as complications related to it is projected to raise phenomenal level globally. The aim of this study was to assess the influence of weight gain during pregnancy on the risk of cesarean delivery of pregnant women attending Benghazi Medical Centre, 2019. A prospective cohort study carried out from 29th December 2018 to 30th May 2019 on pregnant women during second and third trimester until term “Delivery Day” who attend Benghazi Medical Center gynaecology and Obstetrics clinic. Among the total 411 subjects enrolled in the study the prevalence of caesarean delivery is (56.4%). According to the pre-pregnancy BMI categorization only 8.0 % of the subjects were underweight while 45.7 % were in the normal BMI category and 46.7 % were either overweight or obese. Each pre-pregnancy BMI group was subdivided by gestational weight gain low, recommended, or excessive, as defined by the 2009 Institute of Medicine guidelines. Only (56.93%) gained weight within the recommended level. The mean prevalence of excessive weight gain during pregnancy was (35.77%). Maternal age and pre-pregnancy body mass index were associated with more caesarean delivery. Rather than weight or BMI alone, maternal height was found to be a more sensitive indicator of more caesarean delivery. Excessive weight gain during pregnancy was associated with more caesarean delivery. The results of this study are intended to help the government identify the subgroups within pregnant women in Benghazi city who are at greater caesarean delivery risk, who may benefit from early intervention and to guide it towards optimal, timely and cost effective intervention.

Keywords: Influence, Weight, Pregnancy.

INTRODUCTION

Pregnancy, also known as gestation, is the time during which one or more offspring develops inside a woman. Pregnancy can occur by sexual intercourse or assisted reproductive technology. Childbirth typically occurs around 40 weeks from the last menstrual period. Pregnancy is typically divided into three trimesters. The first trimester is from week one through twelve and includes conception, which is when the sperm fertilizes the egg. The fertilized egg then travels down the fallopian tube and attaches to the inside of the uterus, where it begins to form the embryo and placenta. During the first trimester, the possibility of miscarriage (natural death of embryo or fetus) is at its highest. The second trimester is from week thirteen through twenty eight. Around the middle of the second trimester, movement of the fetus may be felt. At 28 weeks, more than 90% of babies can survive outside of the uterus if provided with high-quality medical care. The third trimester is from twenty nine weeks through forty weeks. Prenatal care improves pregnancy outcomes. Prenatal care may include taking extra folic acid, avoiding drugs and alcohol, regular exercise, blood tests, and regular physical examinations. Complications of pregnancy may include disorders of high blood pressure, gestational diabetes, iron-deficiency anemia, and severe nausea and vomiting among others [1-3].

Pregnancy represents a vulnerable life stage relative to a woman's nutritional status. In addition, both the dietary intake and the nutritional status of the woman prior to and during pregnancy greatly influence fetal development and, in turn, pregnancy outcome. Recent research has also shown the profound impact of maternal nutrition status and intake on the infant's risk in adulthood for several chronic diseases such as hypertension and diabetes, largely via birth weight. Several of the complications of pregnancy can also adversely affect nutritional status. For these reasons, nutritional assessment is imperative to help ensure optimal pregnancy outcome [4]. One of the most important aspects of pregnancy is body weight, both pre-pregnancy weight and weight gain during gestation, which significantly influence pregnancy outcome. A woman with either excess or low body weight prior to pregnancy has a higher risk for poor outcome. However, weight gain during pregnancy, specifically total amount and rate, are most correlated with infant birth weight, which in turn is associated with infant health status and mortality [5-8].

Dietary cravings and dietary as well as olfactory avoidance of certain types of food are common in pregnancy. Although the exact mechanisms of these symptoms are not fully explained, it is thought that dietary cravings may arise from the thought that certain foods might help relieve nausea. Pica, which is the intense craving for unusual materials such as clay and ice, has also been reported in pregnancy [10-11]. The birth, growth, and development of a healthy infant depends on a woman's general health and well-being before conception and the amount and quality of care provided during pregnancy. Preconceptual care is an organized, comprehensive program that identifies and reduces women's medical, psychological, social, and lifestyle reproductive risks before conception [12-14].

Requirements for most essential nutrients increase during pregnancy over non-pregnant status. Meeting energy needs during pregnancy is crucial, because of the importance of adequate maternal weight gain to prevent low birth weight. Specific nutrients become “nutrients of concern”, because of their role in gestation and/or low intake. Pregnant women are routinely prescribed a vitamin and mineral supplement, but a healthful daily eating pattern is important. The Food Guide Pyramid can serve as the basis for such a pattern. [(15)] Pregnancy is sometimes referred to as hyper-metabolic state because of the increased need for energy and nutrients to support growth of the fetus, the placenta and maternal tissue. There is substantial variation in nutrient requirements among individuals within a population [14].

The only anthropometric measurements consistently available for pregnant women are height, pre-pregnancy weight, and a series of weight measurements during gestation. Pre-pregnant weight and antenatal weight gain are interrelated predictors of infant birth weight, and the pattern of gestational weight gain can have clinical value. Monitoring of weight changes during gestation is especially important for underweight and obese women, because their pregnancy outcome can be improved by achieving recommended weight gains [16].

As blood volume expands during pregnancy, the fluid volume increases more than the cellular components. This hemodilution means that "normal" values for red blood cells, hemoglobin, and hematocrit are lower for pregnant women than for non-pregnant women. Increasing maternal blood volume affects the assessment of laboratory data, with estimates ranging from an onset at 6 weeks to 20 weeks. In addition, compared to the non-pregnant state, pregnancy also causes changes in specific laboratory constituents [18].

The initial prenatal visit provides the opportunity to identify factors that may increase the risk of an unfavorable outcome of pregnancy. Nutrition-related factors to be considered include anthropometric measures, age, signs of anemia, and chronic disease. During routine prenatal visits, urine is screened for sugar and protein. Blood pressure is measured and clinical signs of edema sought. These are useful in identifying women at risk for gestational diabetes or pregnancy-induced hypertension [19].

Routine assessment of dietary practices is recommended for all pregnant women. The typical pattern of intake can be determined effectively using a food frequency or dietary history questionnaire. Low intake of specific groups of foods, such as those rich in iron or calcium, can be identified quickly [20].

A caesarean section (CS), also known as C-section or Caesar, is a surgical procedure in which incisions are made through a mother's abdomen (laparotomy) and uterus (Hysterotomy) to deliver one or more infants. It is usually performed when a vaginal delivery would put the infants' or mother's life or health at risk; although in recent times it has been also performed upon request for childbirths that could otherwise have been natural[21]. The World Health Organization (WHO) recommended that the rate of CS should not exceed 15% in any country. However, in the last two decades the rate has risen to a record of 46% in China and to levels of 25% and above in many Asian countries, Latin America, and the United States of America (USA) [22]. The first study presented the prevalence of C-section worldwide by Betrán *et al*., which included 155 countries published from 1990 to 2014 that estimated the rate of C-section worldwide as 18.6% with a range from 6% to 27.2%. The rate was higher in developed countries and lower in developing countries. Latin America and the Caribbean region have the highest C-section rate (40.5%), followed by Northern America (32.3%), Oceania (31.1%), Europe (25%), Asia (19.2%), and Africa (7.3%) [23]. C-section indications vary among different populations and countries, and there is no world standard classification system for indications of C-sections. The most common indications for cesarean delivery include previous C-section, multiple pregnancy, breech presentation, fetal distress, lack of progress in labor, small fetus and macrosomia, cord prolapse, transverse or oblique lie of the fetus, head and pelvis mismatch, previa or abruptio placenta, and severe preeclampsia [22, 23]. Little is known about the actual rate of C-section in Libya and what are the indications that are used by doctors to decide on cesarean delivery. This information is even scarce in small cities and regions distant from the capital or large hospitals; the Health Authority and Social Insurance in Libya estimated the rate of C-section as 7.6% in 1996. It has also been reported that the rate of C-section at Al-Jamhouria Hospital in Benghazi in 2009 was 22.4%. In 2011, it has also been reported that the rate of C-section at Al-Jamhouria Hospital in Benghazi raised to26.9%. In Derna city in eastern part of Libya, the overall C-section rate from 2013 to 2016 as high as 23.5%. Moreover, the C-section rates did not differ much between the years with a slight increase in the rate of C-section from 22.8% in 2014 to 24.4% in 2016. According to this limited available research, the cesarean section rate in Libya is considerably higher than the rate recommended by the WHO [24-26].

Amidst an epidemic of obesity, obesity among pregnant women has risen dramatically. The prevalence of obesity among pregnant women ranges from 10-35%. The combination of obesity and pregnancy creates additional risk factors for adverse maternal and infant health outcomes. The increased perinatal morbidity associated with maternal obesity such as preeclampsia, gestational diabetes, stillbirth, abnormal fetal growth, and caesarean deliveries has caught the attention of health care providers, academics and researcher. Long-term adverse outcomes of maternal obesity including childhood obesity are unfortunately becoming well-known. Behavioural and lifestyle factors likely account for the alarming rise in obesity over the past 20 years (33.8% prevalence of obesity in 2008); however, environmental, social, economic, and genetic factors are also intertwined in its etiology. Since the publication of the most recent recommendations for weight gain during pregnancy by the Institute of Medicine, there has been renewed interest in the effect of pregnancy weight gain and the risk of caesarean delivery [25, 27]. Maternal obesity and increased pregnancy weight gain are both associated with increased birth weight rate and caesarean rate [24]. During the past 50 y, pregnancy weight gain has been highly controversial. During the first half of the 20th century, obstetricians restricted weight gain during pregnancy to prevent toxemia, difficult births, and maternal obesity. The policy of severe weight restriction was challenged in the 1960s, when experts began to recognize that the relatively high rates of infant mortality, disability, and mental retardation. In 1970, a review of the scientific evidence by the National Academy of Sciences concluded that the usual practice of restricting maternal weight gain was associated with increased risk of low birth weight. The National Academy of Sciences Committee on Maternal Nutrition concluded that a weight-reduction program that distorts normal prenatal gain should not be followed during pregnancy and increased the formal recommendation for pregnancy weight gain to 9–11.4 kg. A few years after the policy of weight-gain restriction was lifted, average prenatal weight gain in US women increased from ≈9 to ≈12 kg; in some settings, averages were as high as 14 kg [17, 28]. This increase, combined with a need to reassess the burgeoning scientific literature addressing the relation between pregnancy weight gain and various maternal and fetal outcomes, led to a new report from the Institute of Medicine (IOM) of the National Academy of Sciences that reexamined maternal nutrition. Published in 1990, the report confirmed a strong association between pregnancy weight gain and infant size and provided target ranges of recommended weight gains by pre-pregnancy body mass index. In the almost 10 y since the IOM's report was published, a large body of literature has continued to accrue, addressing not only birth weight but also other outcomes related to labor, delivery, and maternal postpartum weight status. In the same period, average pregnancy weight gain in some settings has continued to increase. Despite the widespread measurement of maternal weight gain during pregnancy, almost no data have been published assessing the usefulness or negative consequences of weighing women [27, 29].

Two studies that retrospectively assessed the sensitivity and specificity of this indicator concluded that maternal weight gain alone is neither a sensitive nor a specific predictor of poor pregnancy outcome. Because the amount of total weight gain is widely variable among women with good pregnancy outcomes, and because the perinatal outcomes of interest are multifactorial in origin, no one should expect that weight gain alone is a perfect diagnostic or screening tool. Results of several newer multivariate studies have confirmed that the risk of cesarean delivery increases with increasing weight gain, even after adjustment for birth weight. In a study of >4000 women giving birth to infants at Johns Hopkins University, the odds of cesarean delivery increased ≈4% per kilogram of pregnancy weight gain. Another study of ≈3000 women throughout the United States reported that the risk of cesarean delivery increased with both higher maternal pre-pregnancy weight and BMI measured at 27–31 wk gestation (data on gestational weight gain were not available). In each of these studies, the relation between maternal weight gain and cesarean delivery was continuous and the authors could identify no threshold above which the risk of cesarean delivery increased more rapidly [30, 31].

An analysis of the 1988 National Maternal and Infant Health Survey in United Kingdom (UK) examined the association between pregnancy weight gain and cesarean risk. Women who gained within or below the IOM's recommended ranges had high vaginal delivery distributions, but women who gained >16 kg were much more likely to had cesarean delivery. Recently, researchers have been conducting studies that look at both fetal and maternal outcomes to assess the overall effect of pregnancy weight gain. One study looked at 274 young, women with normal pre-pregnancy BMI in Camden, the authors concluded that the best combination of birth outcome, higher vaginal birth, lower cesarean delivery and postpartum body status was associated with maternal weight gains within the IOM's recommended ranges. [32, 33].

In three Arabic studies in Kingdom Saudi Arabia (KSA), Qatar and Egypt, they found an association between gestational weight gain (GWG) and the risk of cesarean delivery with odd ratios 2.2, 1.3 and 1.6 respectively [34-36]. Herein, the current research presents a comprehensive model for the risk of caesarean delivery. The first primary emphasis is on how maternal anthropometric status, height pre-pregnancy body mass index, and pregnancy weight gain influence the risk of caesarean delivery. The current research asks three primary questions. Is a greater weight gain during pregnancy associated with an increased risk of caesarean delivery? If so, how does this effect explained anthropometrically? Finally, does there appear to be a threshold of pregnancy weight gain above which caesarean risk is differentially increased?

While numerous studies report the negative health impacts of obesity in pregnancy, no published study, as determined by a keyword search (pregnancy, weight gain, caesarean) of the PubMed and MEDLINE electronic databases, has found in Libya; which justify the establishment of the current research. This paper is aiming to study the influence of weight gain during pregnancy on the risk of cesarean delivery of pregnant women attending Benghazi Medical Centre, 2019. It also aims to find out if there is a threshold of pregnancy weight gain above which caesarean risk is differentially increased. The research also aims to o find out the possible association of additional select socio-economical factors, physical activity, medical, and dietary factors associated with caesarean risk.

SUBJECTS AND METHODS

Study population and design

This was a prospective cohort study carried out from 29th December 2018 to 30th May 2019 on pregnant women during second and third trimester until term "Delivery Day" who attend Benghazi Medical Center "BMC" gynaecology and Obstetrics clinic. The inclusion criterion for enrolment in the present study was all pregnant women who had a body weight record for the pre-pregnancy period at least one month before pregnancy and monthly weight record during pregnancy; and the type of delivery. Multiple pregnancies and pre-term delivery were excluded. Based on this criterion a total of 462 pregnant women were assessed between 17th January 2019 to 30th April 2019 (Period of data collection) were randomly approached to participate in the study. Out of the 462 pregnant women, 14 refused to participate in the study and 37 subjects were excluded from the study because they were unable to answer all the questions required for the study. The most common data item missing was pre-pregnancy weight. A total of 411 pregnant women who answered the complete questionnaire clearly were finally enrolled for the study giving a response rate of 88.96 %. The pregnant women were approached at the respective hospital and briefed about the purpose of the study before questionnaire was interviewer administered. The questionnaire was divided into various sub-sections. It includes socio-economic information, clinical history, anthropometric evaluation, physical activity and current treatment as per the clinical practice guidelines of the Standards [37]. The first section covered various characteristics like age, number of children, week of pregnancy, number of normal deliveries, number of caesarean deliveries, number of abortion. The second section covered various medical characteristics like presence of chronic disease, family history; type of used medications. Physical activity levels were also defined based on the contribution of the type, amount and frequency of the self-reported activities of the subjects [38].

The next part of the questionnaire had a section for obtaining information pertaining to nutritional intake like self perceived food allergies, food aversions and nutritional supplement. The last section of the questionnaire collected information about type of the delivery. Pre-pregnancy height and weight measurements used to calculate pre-pregnancy Body Mass Index (BMI) as recommended by the Institute of Medicine. (Table1). Pre-pregnancy weight was self reported by the pregnant women. This is one of the limitations of this study. Monthly Weight was measured with a SECA Platform lever scale (Germany) to the nearest 0.25 Kilogram (kg). Height or stature was measured using telescopic height rod attached to the SECA scale and recorded to the nearest 0.5 Centimetre (cm). Pre-pregnancy weight and height were self reported by the pregnant women. BMI was calculated from these self-reported values using the formula Pre-pregnancy weight divided by height squared (kg/m^2). Pregnancy weight gain was calculated by subtracting the pre-pregnancy weight from the weight measured at each monthly prenatal visit up to delivery. Net maternal weight gain was also calculated (pregnancy weight gain minus the infant birth weight). Each BMI group was subdivided weight gain was classified as low, recommended, or excessive, as defined by the 2009 Institute of Medicine guidelines [17].

All data was coded prior to being entered in a computer. Description and analysis of data was done by *Statistical Package for the Social Sciences* (SPSS) version 22. Level of significance was set at p value < 0.05. Descriptive Statistics were used to compare mothers who delivered by caesarean with those who delivered vaginally. Individual variables were compared using *t* test for continuous variables and x^2 *for* categorical data. The distribution of contiguous variables for both group ((vaginal and caesarean)) delivery was examined to determine whether they differed. Continuous variables that showed distributional differences were converted into categorical variables and analysed to explore their significance as thresholds for increased or decreased risk of caesarean. Variables that were found to differ between the two groups were entered in to a logical regression model, with caesarean delivery as the dependent variable.

RESULTS

The subjects were predominantly between the ages 20-39 years old (60.40 %). The remaining half was between less than twenty years (15.60 %) and 40-48 years old (24 %). The total means age ± SD was 25.8 years ± 4.5 years. Most of the subjects (97.5 %) were of Libyan. Aalthough most of the subjects had some sort of formal education; it was mostly as secondary level (48.18 %) with fewer percentages with university education or its equivalent (32.36 %). The unemployed formed the highest segments of the subjects: (54%). Most of the subjects subsided on monthly family incomes of higher than 500 Libyan Dinars (LD); about a (47.93 %) had access to monthly family income of 500 – 1000 LD, while about (47.45%) of the subjects had access to monthly family income of more than 1000 LD.

Table-1: Subject characteristics

Characteristics	**Total**	
	Female	
	No.	**%**
Age (year)		
<20	63	15.60
20-39	248	60.40
40-48	100	24
Total	**411**	**100**
Age (Years) Mean ± SD 25.8± 4.5		
Libyan	400	97.5
Others	11	2.5
Illiterate	3	0.73
Basic education	77	18.73
Secondary and its level	198	48.18
University level	133	32.36
Employed	189	46
Unemployed	222	54
Monthly family income (LD)		
< 500	19	4.62
500-1000	197	47.93
> 1000	195	47.45

The most common three disorders among subjects were gastrointestinal disorders and Gestational Diabetes Miletus (GDM) with percentages of (27.01%) and (21.65%) respectively. The distribution of delivery types among the last giving birth almost equalled with percentages of (48.66%) and (47.20%) for vaginal and caesarean delivery respectively. Within the current studied delivery; the caesarean delivery was more than half of giving birth with percentage of (56.4%) as shown in table (2). Most of the subjects were sedentary (94.6 %) at the time of the study while the remaining subjects were reported to be engaged in low physical activity (5.4%). Most of the Subjects (91.7 %) had not been prescribed any special pregnancy diet and among the small number that was (8.3 %), most of them were prescribed it by their physician (59 %) and were mostly compliant over it (73.5 %). According to the pre-pregnancy BMI categorization only 8.0 % of the subjects were underweight while 45.7 % were in the normal BMI category and 46.7 % were either overweight or obese. Each pre-pregnancy BMI group was subdivided by gestational weight gain low, recommended, or excessive, as defined by the 2009 Institute of Medicine guidelines. Only (56.93%) gained weight within the recommended level. (35.77%) of the subjects gained excessive weight during pregnancy.

Table-2: Maternity characteristics of subjects

Characteristics	**No**	**%**

Chronic Diseases		
No	13	3.16
DM	11	2.68
GMD	89	21.65
Hypertension	29	7.06
Heart Diseases	11	2.68
Renal Diseases	38	9.25
GIT Disorders	111	27.01
Others	21	5.11
Comorbidity	88	21.41
Last Delivery		
No ((the current is the first))	17	4.14
Normal	200	48.66
Caesarean	194	47.20
Current Delivery		
Normal	179	43.6
Caesarean	232	56.4
Number and Type Pervious Delivery		
Normal		
0-3	*75*	*18.25*
4-6	*87*	21.17
>6	6	1.46
Cesarean		
0-3	115	27.98
4-6	77	18.73
>6	14	4.41
Abortion		
0-3	10	2.43
4-6	23	5.6
>6	4	0.97
Physical activity level		
Sedentary	389	94.6
Low active	22	5.4
Diet		
Yes	34	8.3
No	377	91.7
Diet prescribed by		
Physician	20	59
Dietician	9	25
Self	5	16
Diet compliance		
Yes	25	73.5
No	9	26.5
Pre-pregnancy BMI Underweight	33	8.0
Normal	188	45.7
Overweight or obese	190	46.3
Gestational Weight Gain		
Underweight Group		
Low	5	1.22
Recommended	11	2.68
excessive	17	4.14
Normal Group		
Low	16	3.89
Recommended	101	24.57
excessive	71	17.27
Overweight or obese Group		
Low	9	2.19
Recommended	122	29.68
excessive	59	14.36

A Chi Square test was carried out to see if there was any statistically significant association between the caesarean delivery with various maternal and non maternal factors including socio-economical factors.

Greater pre-pregnancy BMI, greater gestational weight gain, and shorter height women were associated with caesarean delivery ($p < 0.05$) as shown in table 3. Maternal mean age is higher among the caesarean group (26.7±5.7 years) comparing to the vaginal delivery group (24.3±4.6 years). Maternal mean pre-pregnancy BMI is higher among the caesarean group (24.7±5.9 kg/m^2) comparing to the vaginal delivery group (23.1±4.7 kg/m^2). Maternal mean GWG is higher among the caesarean group (7.8 kg) comparing to the vaginal delivery group (6.8 kg). In the multivariate model greater pregnancy weight gain remained a significant risk factor for caesarean delivery as shown in table 7. Predictors of caesarean delivery are summarised in table (4). In the full model maternal age is associated with caesarean delivery with odd ratio 1.97 (Confidence Interval C.I = 1. 6-2.08). Maternal height ≤ 1.57 meter is associated with caesarean delivery with odd ratio 1.56 (Confidence Interval C.I = 1.32-1.85). Pre-pregnancy BMI is associated with caesarean delivery with odd ratio 1.53 (Confidence Interval C.I = 1.4-2.17). GWG is associated with caesarean delivery with odd ratio 1.56 (Confidence Interval C.I = 1. 2-1.64). Maternal height ≥ 1.73 meter is associated with less caesarean delivery 0.625 (Confidence Interval C.I = 0.469-0.832). During the analysis of current research data; there is no threshold of pregnancy weight gain above which caesarean risk is differentially increased. It is more associated with Pre-pregnancy BMI and total pregnancy weight gain rather than specific threshold.

Table-3: Association of caesarean delivery with various maternal

Characteristics	Caesarean Deliveries N =232	Vaginal Deliveries N=179
Maternal Age (years)	26.7±5.7	24.3±4.6
Pre-pregnancy BMI (kg/m^2)	24.7±5.9	23.1±4.7
GWG (Kg)	7.8	6.8
Maternal Height (m)	36.1%	27.5%
<1.57 meter	56.4%	61.3%
>1.57meter-<1.73 meter	7.5%	11.2%
≥ 173 meter		

Table-4: Logistic regression Model for the risk of caesarean delivery

Variables	Odd Ratio (OR)	Confidence Interval 95%
Maternal Age (years)	1.97	1. 6-2.08
Pre-pregnancy BMI (kg/m^2)	1.86	1. 4-2.17
Gestational weight gain (kg)	1.53	1. 2-1.64
Maternal height ≤ 1.57 meter	1.56	1.32-1.85
Maternal height ≥ 1.73 meter	0.625	0.469-0.832

DISCUSSION

In the various global studies studying the caesarean delivery, covering over 300,000 subjects in various settings, the caesarean delivery had a mean prevalence of 14-50 %, comparable to our study finding of 56.4 %. Nutrition is an important, controllable component of preventive health care [39]. It is suggested that there should be an earlier preventive approach through recognition of risk factors that may lead to cesarean delivery. Identification of the factors specific to each country would make it possible to target groups or individuals who may be susceptible to cesarean delivery. Once the risk factors have been identified, appropriate policies can be adopted so that action can be taken [40]. The impact of increased BMI in the general population has been the focus of many studies, but studies pertaining to pregnant women are few. What studies have been reported have all been from Western countries; and few and limited Arabic studies. There are no Libyan studies on pregnant women. The findings of Western studies may not apply to the Libyan population [41, 42]. The results of the analysis indicate that the risk of caesarean delivery increases with greater maternal age, greater pre-pregnancy BMI, maternal height of 1.57 meter or less, and pregnancy weight gain. In contrast, maternal height of 1.73 meter or more was associated with decreased risk of delivery by caesarean.

In this study age group was associated ($p < 0.05$) with caesarean delivery. As the age group decreased there was a lowering in the rate of caesarean delivery. Ageing is generally associated with a decline in various physiological functions. Increasing age has also been linked with a higher incidence for disease and disability both of which reduce food intake**.** This age related occurrence and chronicity of medical illnesses associated with impaired ability of vaginal birth [43, 44] maternal age appears to be an independent risk factor for cesarean delivery. The reasons for this clinically important and statistically significant increased risk are unclear, but may be due to physicians and patients concern over pregnancy outc.ome in older women. In a systematic review included twenty-one studies demonstrated an increased risk of cesarean birth among women at advanced maternal age compared with younger women. The most common justifications have been concern over pregnancy outcome and pregnancy related diseases such as GDM and preeclampsia [45].

Who are obese before pregnancy is at increased risk for cesarean delivery. This was the results of several publications. Many authors have discussed the concept of soft-tissue dystocia in maternal pelvises by the accumulation of fat tissues, narrowing the genital tract. Although to our knowledge, there is no direct support of this concept by medical imagery studies, some indirect arguments plead for its reality: for example, for identical birth weights, there are more caesarean sections, instrumental extractions or failure to induce labour in obese women than in controls [46]. Furthermore, according to Durnwald *et al.*, among women with a history of caesarean section, those having a normal BMI at the first pregnancy but an overweight at the second one presented a decreased rate of vaginal delivery as compared with those who kept a stable BMI between the two pregnancies. Recent research reflects that the caesarean delivery risk due to pre-pregnancy excess weight appear to be one of the most preventable public health issues. Moderate intentional weight losses in overweight women before pregnancy provide some beneficial effects like improving vaginal delivery rate. Weight loss in the pre-pregnancy period may be detrimental to health, particularly in the absence of co-morbidities risk factors. So perhaps the best advice is to avoid unwanted weight gain in mid-life, then maintain the lean body weight in advance age[47].

Maternal height of 1.57 meter or less has associated with more caesarean delivery in the current study. While maternal height of 1.73 meter or more has associated with more vaginal delivery. This result is similar with other research worldwide even with populations who have different height characteristics from Libya. Anthropometric standards are often used to determine whether the pregnancy standard of women is satisfactory to establish a vaginal delivery. Anthropometric measurements like weight, height, indicators of muscle and subcutaneous adipose tissue are considered to be an accepted measure of selection of delivery type. Height has been found to be associated with functional ability, of pelvis among pregnant women. There are references cut off values of different populations for height intended specifically for use among pregnant women to be classified according to the degree of which caesarean delivery should be used [48]. Women's height is correlated to pelvic size and is currently used to predict cephalopelvic disproportion. Measurements of maternal height and the transverse diagonal of the Michaelis sacral rhomboid area using a measuring tape may represent a simple method to detect nulliparous women at risk for cephalopelvic disproportion. [49].

During the past 50 years, recommendations for pregnancy weight gain have been highly controversial. In the current research more ppregnancy weight gain is associated with caesarean delivery. Monitoring weight gain in pregnancy might help clinicians to target nutritional, medical, and social services to women at high risk of poor pregnancy outcome. Unfortunately, no published experimental studies that examined whether it is possible to manipulate pregnancy weight gains and change pregnancy outcomes. Without the results of well-designed experimental trials, clinical protocols for managing weight gain in pregnancy cannot easily satisfy the criteria for evidence-based medicine. Results of several newer multivariate studies have confirmed that the risk of cesarean delivery increases with increasing weight gain, even after adjustment for birth weight. These data suggest that there may be a modest but consistent dose-response relation between pregnancy weight gain and cesarean delivery but, because there is no obvious threshold, it is difficult to determine what cutoff for gestational gain would be desirable to reduce cesarean delivery. When absolute weight gain (total pregnancy weight gain minus birth weight and placental weight) was used in the multivariate analysis, excessive weight gain was still an independent predictor of cesarean delivery. Although macrosomia was a stronger predictor of cesarean than weight gain alone, excessive weight gain was much more common than macrosomia in the current cohort [50-52]. To improve the understanding of the mechanisms of these relationships, future studies should examine pattern of gain; they should stratify analyses on the different subtypes of preterm delivery and provide more detailed descriptions of methods for assessing gestational duration.

The limitations of the current research include self reporting of pre-pregnancy weight and height. Cesarean delivery is the result of multi-maternal and fetus variables; the time and cost prevent the researchers from include all these variables. However, strict control over confounding variables during statistical analysis has been established. Like all observational studies, the selection bias can result from inaccurate reporting of height and weight for estimating pre-pregnancy BMI. Although self-reported height and weight may be underreported and over-reported, other studies have shown self-reported weight to be highly correlated and within 3 lb of the actual measured weight [53]. The findings of this research have several clinical and public health implications. The results support the current IOM gestational weight gain guidelines for women with normal pre-pregnancy body BMI and who deliver a full-term singleton infant.

CONCLUSION

The mean prevalence of excessive weight gain during pregnancy was (35.77%). Maternal age and pre-pregnancy body mass index were associated with more caesarean delivery. Rather than weight or BMI alone, maternal height was found to be a more sensitive indicator of more caesarean delivery. Excessive weight gain during pregnancy was associated with more caesarean delivery. The results of this study are intended to help the government identify the subgroups within pregnant women in Benghazi city who are at greater caesarean delivery risk, who may benefit from early intervention and to guide it towards optimal, timely and cost effective intervention. All pregnant in Benghazi should be routinely screened for pre-pregnancy BMI and pregnancy weight gain. Early nutritional intervention strategies including nutrition education, involving a multidisciplinary team of clinicians, dieticians and nursing staff should be implemented with an appropriate follow up. Multi faceted and tailor made strategies to counteract specific malnutrition need to be planned, implemented, monitored and evaluated among the malnourished and at nutritional risk pregnant women. Nutritional intervention programmes planned for the pregnant women in general and should have a focus on those belonging to a lower or upper pre-pregnancy BMI level. Additional studies need to be carried out among pregnant women in different settings as well as other regions of Libya to identify the specific prevalence of malnutrition and factors associated with it.

Competing Interests
Authors have declared that no competing
Interests exist.

Ethics

Informed consent was obtained from the subjects who were also assured of the confidentiality of the information collected. The research was approved by the administration of the concerned hospital. Prior to the start of the project the respective hospital administration were informed in writing about the aim of the study to obtain the maximum possible cooperation to conduct the study.

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