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Association of Pre-gestational Overweight and Obesity with Cesarean Section Delivery

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Original Article

ABSTRACT

Background: *Pre-pregnancy overweight and obesity showed to have significant impact on pregnancy outcomes and cesarean section. Nonetheless, this association still need further clarification.*

Objective: *To assess the association between maternal pre-pregnancy overweight and obesity as risk factor for cesarean section.*

Patients and Methods: *This was a case control study conducted during a period of 18 months from 2018 through 2020 included 100 Sudani women who were delivered by cesarean section and 100 women delivered vaginally.*

Both groups almost matched for their demographic and obstetrical characteristics . Frequency of overweight and obesity was measured in both groups and compared. Estimation of risk was performed according to odds ratio. All statistical tests applied accordingly at 0.05 level of significance.

Results: *In Cesarean section group 32% of women were overweight 32% and 27% obese . In group 2, 20% overweight and 16% obese, the prevalence of pre-gestational overweight \ obesity was significantly higher in cesarean section group than controls (virginal delivery) group, (P. value = 0.004), women with pre-pregnancy overweight or obesity were about 2.6 fold more likely to be delivered by cesarean section than pregnant women who were not overweight or obese (odds ratio = 2.6).*

Conclusion: *Pregestational overweight and obesity increase the risk of completing a pregnancy by cesarean section more than twice compared to those of normal weight. And they are independent risk factors for cesarean section*

Keywords: *Pre-pregnancy overweigh and obesity, pregnancy outcome, mode of delivery, cesarean section,*

1. INTRODUCTION

According to the reports of the World health organization (WHO), the rate of cesarean sections has increased worldwide, particularly in developing countries (1), however, recommendations of the WHO show that an ideal cesarean section rate should not exceed 10 to 15% (2). The evolution of cesarean deliveries in Sudan, and the rates are above the WHO recommendations and since 2008 the rate of CS are steadily increases (3), nonetheless, CS beyond these levels did not reduce maternal and perinatal mortalities (4). However, different predisposing factors, some of them are maternal, fetal or ovular (5). Among the maternal causes: the pregnancies of overweight and obese women have been associated with a greater number of complications during pregnancy, such as gestational diabetes, hypertensive disease of pregnancy, pre-eclampsia, maternal infections (urinary or endometritis), thromboembolic disease, fetal and perinatal death (6,7). As during the delivery process, obstetric complications also increase in pregnant women with a higher body mass index (BMI). Increases the number of chronologically prolonged pregnancies , labor inductions, hours of labor, instrumental deliveries and the number of cesarean sections (8–10). In addition, it has been described that the risk of cesarean section increases as BMI increases, where obese and overweight pregnant women had a higher incidence of caesarean sections than pregnant women with normal weight (8). The risk of cesarean section in overweight pregnant women was practically double with respect to those of normal weight. Obese women underwent three times caesarean sections than normal weight women (11,12).

Obesity proved to be the most common health problem in women of reproductive age, additionally, obesity in pregnant women may lead to possible complications associated with the pregnancy itself (12). Therefore, it necessary to analyze the association between overweight and pre-pregnancy obesity and cesarean delivery, since overweight and pre-pregnancy obesity has become a frequent maternal diagnosis, exposing pregnancy to complications during delivery and puerperium(11). The WHO defines obesity as an abnormal or excessive accumulation of fat that can be detrimental to health . It is a complex multifactorial chronic disease influenced by genetic, physiological, metabolic, cellular, molecular, social and cultural factors . It is a chronic metabolic disorder caused by an imbalance between food intake and energy expenditure that results in an excessive amount of fat tissue stored in the form of triglycerides. It is determined in adults when there a BMI

equal to or greater than 30Kg / m 2 (13,14).

The fundamental cause of overweight and obesity is an energy imbalance between calories consumed and calories expended. There has been a universal trend to have a higher intake of foods rich in fat, salt and sugars, but poor in vitamins, minerals and other micronutrients. The other important aspect is the decrease in physical activity as a result of the sedentary lifestyle due to the greater authorization of work activities, modern methods of transport and urban life (15). In its etio-pathogenesis, it is considered to be a multifactorial disease, recognizing genetic, environmental, metabolic and endocrinological factors. Only 2 to 3% of obese patients would have an endocrinological pathology as a cause, among which hypothyroidism, Cushing's syndrome, hypogonadism and hypothalamic lesions associated with hyperphagia stand out. However, it has been described that the excessive accumulation of fat can secondarily produce alterations in the regulation, metabolization and secretion of different hormones. Therefore, we can consider obesity a chronic disease, multifactorial in its origin and that presents with a wide range of phenotypes (15).

The international obesity classification for an adult is proposed by the WHO according to BMI. It can be seen that for a given height and weight, the percentage of body fat is around 10% higher in women than in men. The foregoing suggests that women have a better adaptation to body fat than men, because a large part of the fat is distributed in subcutaneous and peripheral compartments (breasts, buttocks, thighs), while in men excess fat tends to be deposited in the abdomen, both subcutaneous fat and intra-abdominal fat. On the other hand, it has been established that as people age, their body fat content increases, despite maintaining stable weight. However, to classify a subject as obese in practice, we use the measurement of body weight or the calculation of indices based on weight and height (BMI), according to as established in International Consensus. A BMI equal to or greater than 30 Kg / m^2 is the clinical indicator used universally to diagnose obesity in both sexes.

The advantage of BMI is based on the fact that there is a good population correlation (0.7-0.8) with body fat content, and because cut-off points have been demonstrated for the diagnosis of obesity. Several limitations have been raised for the use of BMI as an indicator of obesity. Among these, it is suggested that, at the individual level, BMI is not a good indicator of body composition, since it does not distinguish in terms of the contribution of lean mass and fat mass in weight. On the other hand, the BMI does not measure the changes

that occur in body fat with changes in age, physical training and in ethnic groups with different body proportions in terms of limb length and height in a sitting position (16)

Classification and risk assessment of obesity (17,18)	
BMI (kg/m^2)	Risk Associated to Health
18.5 – 24.9 (normal)	Average risk
25 – 29.9 (Overweight)	Increased risk
30 – 34.9 (Obesity grade I)	Moderate risk
35 – 39.9 (Obesity grade II)	High risk
≥ 40 (Obesity grade III, morbid obesity)	Very high risk

The consequences in labor are: induction of labor, preterm labor, prolonged labor, caesarean section, shoulder dystocia and complications during obstetric anesthesia. Induction of labor: It is more frequent in obese women, although the causes are not clear. The increase in chronologically prolonged pregnancies could be a contributing factor (19,20).

Preterm delivery: Although different meta-analyzes and systematic reviews agree that obesity does not increase the prevalence of spontaneous prematurity, iatrogenic prematurity (due to maternal medical causes) is higher than the population of pregnant women with normal weight (21). Prolonged labor: Although studies on labor in obese women are limited, cohort studies in nulliparous women show that with increasing maternal weight, the speed of cervical dilation slows, both in inductions and in women with spontaneous labor. It was observed that the time required to advance from 4 to 10 cm of dilation in obese women was 7.5 to 7.9 hours, compared to 6.2 hours in women of normal weight (22). Shoulder dystocia: Although fetal macrosomia is a risk factor for shoulder dystocia, the absolute risk of severe shoulder dystocia associated with permanent injury or death is low (23). Obstetric anesthesia: In obese pregnant women, anesthetic complications are more frequent, due to the increase in the number of attempts and the failure rate of epidural anesthesia, inadvertent dural puncture and difficulty in intubation, among others, the early placement of an epidural or intrathecal catheter could avoid the need for general anesthesia, for this reason, an early evaluation of all obese pregnant women by the anesthetist would be recommended (24,25) .

Cesarean section is classified according to the obstetric history of the patient: primary is the one performed for the first time; Iterative is the one practiced in a woman with a history of two or more cesarean sections. According to the indications. Elective caesarean section, indication determined during prenatal monitoring and allows time to schedule surgery in the

best conditions ; Cesarean section in progress. A delivery or remedy is indicated and performed during the course of delivery for various problems, usually dystocia. They include pelvic head disproportion , failed labor induction, procrastination or descent dystocia, or parked labor. Emergency cesarean section, one that is decided unexpectedly by the presence of a sudden-onset pathology that requires the termination of the pregnancy as soon as possible, but respecting the admission requirements to operating room (26). Fetal indications include fetal distress, hypoxemia, and fetal acidosis during labor can lead to intra-partum or neonatal fetal death, as well as neonatal respiratory morbidity and subsequent neurological injury. Due to poor fetal presentation, cases with a fetus in a transverse position at delivery or with a mentoposterior or frontal presentation are indications for caesarean section. So are deflected cephalic presentations, when labor progress is difficult, behaving as relative fetopelvic disproportions. Breech presentation is an indication for caesarean section in preterm delivery, mainly if a very low fetal weight is estimated due to fetal fragility and the risk of head entrapment in an insufficiently dilated cervix, also in cases of incomplete breech presentation due to the risk of cord prolapse.Due to prematurity, obstetric and neonatological experience indicates that the premature fetus has a greater risk of obstetric trauma if it is born vaginally, even more, if it comes in breech. For this reason, it is recommended that fetuses weighing less than or equal to 1500g should be delivered by cesarean section. Third trimester hemorrhage, and placenta previa are indicated for caesarean section when the pregnancy is at term and partial or complete obstruction of the cervical canal persists or when significant bleeding occurs at any time during pregnancy. Patients with a diagnosis of moderate or severe placental abruption should undergo cesarean section immediately; when the detachment is mild; Cesarean section will be performed when the baby is alive and showing signs of fetal distress (27,28).

Despite its high safety, cesarean section is not free of complications, some imposed by the indication for the procedure itself (maternal situations of extreme urgency), and others derived from the technique itself. It is not correct to ignore the increase in neonatal and maternal morbidity that derives from its practice, The need for transfusion, with its particular complications. There is the possibility of damage to neighboring organs and sometimes paralytic ileus occurs, which are very rare in vaginal delivery. The fact of requiring anesthesia constitutes a source of eventual complications. The postoperative period is much

more annoying and prolonged. Its cost is also higher than that of vaginal delivery(29,30). Intraoperative complications are infectious complications, they are the main cause of morbidity associated with cesarean section. Factors such as emergent cesarean section, duration of labor, ruptured membranes, socioeconomic status, number of vaginal examinations, urinary tract infections, anemia, severe blood loss, obesity, diabetes, surgical technique, and experience of the surgeon are involved in the incidence of such a complication(31). Although there are several international studies that analyzepre-pregnancy obesity or overweight and caesarean section, few studies are found in our country, therefore we consider the importance of studying this association, in order to guide interventions that can reduce cesarean sections and increase vaginal deliveries .

2. PATIENTS and METHODS

This was an observational case –control comparative study, conducted in our hospital during the period of 18 months, 2018 through 2020. Included 100 pregnant women delivered by cesarean section (cases group) and 100 pregnant women delivered vaginally (as control group).

Inclusion criteria

1. Age 18-35 years
2. Woman delivered by cesarean section or vaginally
3. Give alive newborn
4. Agree to participate in the study
5. Her pre-gestational BMI is known
6. Has a Perinatal card

Exclusion criteria :

Woman was excluded from the study if she had one or more of the following:

1. Nonviable pregnancy
2. Stillbirth, congenital anomalies of the newborn
3. Complicated pregnancies or labor
4. Multiple pregnancy gestation
5. Pregnant women with chronic diseases

Data collection:

Data collected using a pre-constructed data collection sheet (Questionnaire) included the following :

1. Demographic characteristics of the study participants.
2. Obstetrical history
3. Medical and surgical history , assessing the presence of chronic diseases.
4. Mode of delivery of current pregnancy.
5. Pregnancy outcomes; maternal and fetal outcomes, perinatal and postnatal complications.

Data processing and analysis plan

A non-probability sampling was used paired by date of care ± 1 day and district of origin, woman asked to participate in the study and their data were reported after agreement. Medical records were revised until the defined sample size was completed, taking into account the inclusion and exclusion criteria. Given that the present study was carried out with assurence of all ethical consideration and an informed consent was obtained from all participants. Information was recorded on the data record sheet which was prepared by the researchers. All information collected was processed and analyzed, after data quality control, eliminating any error or inconsistency. Statistical analysis was carried out through the statistical package for social sciences ,SPSS, software version 25. Quantitative and qualitative variables were analyzed with appropriate statistical tests, for the determination of associations the statistic, Odds ratio (OR) with its 95% confidence intervals (95%CI), was applied at a significance level of P. value <0.05.

3. RESULTS

Within the descriptive analysis of 200 pregnant women delivered in our hospital, 100 women of them delivered by cesarean section (Group 1as cases group) and the other 100 women delivered vaginally (Group 2 as control group), the mean age of women was 27.1 and 27.3 in group 1 & 2, respectively and ranged 18-35 years in both groups. In both groups, majority of women had secondary or higher level of education, almost one-third in each group were employed and almost half were housewives while 15 women in group 1 and 13 in group 2 were students. Majority of women in both groups were residents of urban areas, (**Table 1**).

The obstetrical history of the studied groups is shown in (**Table 2**) .

For both groups, a median of 39 week-gestation was found for gestational age at labor, a median of 2 for the number of pregnancies, a median of 2 for the number of deliveries and a median of 7 for the number of prenatal checkups.. Both groups were neither significantly different in demographic nor obstetrical characteristics and they were almost matched for these characteristics , in all comparisons, P. value was insignificant > 0.05.

Regarding pre-pregnancy BMI categories of the studied group, it had been found that in Cesarean section group, women with normal BMI were 41% , overweight 32% and obese women were 27%. In group 2, 64% of women had normal BMI, 20% overweight and 16% obese, the prevalence of pre-gestational overweight \ obesity was significantly higher in cesarean section group than controls (virginal delivery) group, (P. value = 0.004), further distribution was performed according to BMI of $\geq$ 25 to include both overweight and obese women , which revealed that 59% of women in group 1 and 36% in group 2 were overweight or obese indicated higher prevalence of overweight/obesity in group 1 than group 2, reflected a significant association between being overweight or obese and cesarean section mode of delivery, with an odds ratio (OR) of 2.6 , women with pre-pregnancy overweight or obesity were about 2.6 fold more likely to be delivered by cesarean section than pregnant women who were not overweight or obese, (**Tables 3 and 4**).

Further comparison of the mean BMI between the studied group, revealed that cesarean section group had significantly higher BMI value than controls; 27.7 ± 4.1 kg/m^2 vs. 25.8 ± 3.6 kg/m^2 , (P. value < 0.001, highly significant), (**Figure 1**).

Table 1. Demographic characteristics of the studied groups						
Variable		Group 1		Group 2		P. value
		No.	%	No.	%	
Age (year)	18 - 26	43	43.0	41	41.0	0.886 ns
	27 - 35	57	57.0	59	59.0	
	Mean (SD)	27.1 (6.2)		27.3 (5.8)		0.814 ns
	Range	18 - 35		18 - 35		
Education	Primary	17	17.0	14	14.0	0.841 ns
	Secondary	35	35.0	36	36.0	
	Higher	48	48.0	50	50.0	
Occupation	Employed	36	36.0	33	33.0	0.793 ns
	Housewife	49	49.0	52	52.0	
	Student	15	15.0	13	13.0	
Residence	Urban	83	83.0	79	79.0	0.588 ns
	Rural	17	17.0	21	21.0	
SD: standard deviation of mean, ns: not significant *Group 1: cesarean section group. Group 2: Vaginal delivery group*						

Table 2. Obstetrical characteristics of the studied groups						
Variable		Group 1		Group 2		P. value
		No.	%	No.	%	
Age at menarche (year)	9 - 10	39	39.0	37	37.0	0.851 ns
	11 - 12	45	45.0	44	44.0	
	13 - 14	16	16.0	19	19.0	
	Mean (SD)	11.1 (1.7)		11.2 (1.4)		0.892 ns
	Range	9 – 14		9 - 14		
Gravida	1 - 2	63	63.0	65	65.0	0.867 ns
	3 - 4	28	28.0	28	28.0	
	> 4	9	9.0	7	7.0	
Parity	Nulliparous	22	22.0	20	20.0	0.673 ns
	1-2	68		66	66.0	
	3-4	10		14	14.0	
Abortion	Yes	5	5.0	7	7.0	0.765 ns
	No	95	95.0	93	93.0	
Median prenatal checkups		7	-	7	-	1.00 ns
Median gestational age at labor		39	-	39	-	1.00 ns
SD: standard deviation of mean, ns: not significant *Group 1: cesarean section group. Group 2: Vaginal delivery group*						

Table 3. Comparison of the studied group according to BMI categories

BMI category	Group 1		Group 2		P. value
	No.	%	No.	%	
Normal	41	41.0	64	64.0	0.004 sig
Overweight	32	32.0	20	20.0	
Obese	27	27.0	16	16.0	

SD: standard deviation of mean, sig: significant,
Group 1: cesarean section group. Group 2: Vaginal delivery group

Table 4. Association between pre-pregnancy overweight or obesity and cesarean sections

BMI category	Group 1		Group 2	
	No.	%	No.	%
Overweight \ Obese	59	59.0	36	36.0
Normal	41	41.0	64	64.0

Odds ratio (OR) : 2.6

95% confidence interval of OR : 1.45 - 4.53

P. value < 0.001 (highly significant)

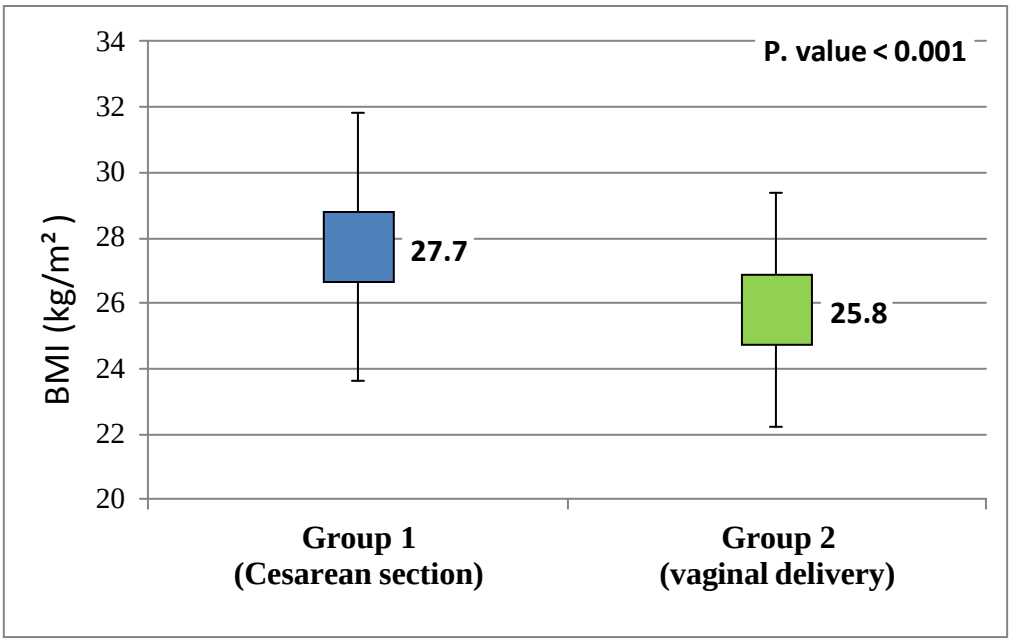

Figure 1. Comparison of mean BMI between the studied group

4. DISCUSSION

Recent studies showed that many women die from pregnancy complication and labor, vast majority of them in the developing countries . Many studies worldwide suggest that pre-pregnancy obesity have an adverse effect on the outcomes of pregnancy (10) . A large body of evidence proves a positive correlation between higher pre-pregnancy BMI and CS delivery which reflects a higher risk of complicated delivery in comparison to women with normal body weight (4,8,32,33). Most of the studies in this regards come from developed countries where obesity is more prevalent, however, obesity in developing countries still represent a significant health problem due to lack of awareness (34,35). However, the relationship between pre-gestational maternal BMI and rate of cesarean section still not well clarified, hence , we aimed in this study to assess the relationship between Pre-pregnancy maternal BMI and the incidence of cesarean section among group of Sudani women,therefore, a case-control observational study was performed in our hospital including 100 pregnant women delivered with CS and 100 pregnant women delivered by virginal delivery,

all included women met the inclusion criteria and those who did not, were excluded. All participant women were at term gestation and agreed to participate in the study. Both groups

were almost matched for their baseline demographic and obstetrical characteristics regarding maternal age, occupation, education, residence, gravidity, parity and history of abortion, in all comparisons of these variables, P. value > 0.05, not significant. In our study, it was found that within the socio-demographic characteristics, mean age was 27.1 and 27.3 years in the cesarean section and vaginal delivery group, respectively; however, we almost matched both groups regarding their demographic and obstetrical history, this matching is important in such studies to control confounding effect of patients characteristics on the mode of delivery, as there are different factors could be associated with the cesarean section option, hence, matching will overcome the effect of these factors and restrict the comparison according to BMI only (36,37). Regarding the obstetric characteristics for both groups (cesarean section and vaginal delivery) a median gestational age of 39 weeks was found, a condition confirmed by Xiong et al (7), which reports a mean of 40 weeks of gestation. Similar results were obtained in the number of pregnancies , in other studies (38,39). Our study observed that the pregnancies of women who are overweight and obese reached 42 weeks of gestation, a prolonged pregnancy, which increases the risk of obstetric complications which supported the findings of previous studies (11,33). From other point of view, obesity increases the risk of cesarean section complications as it was reported by Saadia Z in 2020(11), Regarding pre-pregnancy overweight and obesity, our study shows that this excess nutritional disorder is present in women of childbearing age under 35 years of age, the age range in which this disorder is observed most frequently ranges from 27 to 31 years. as did the studies by Bianchi et al. (38) , Papachatzi et al. (39) and Vinturache et al. (8) . We found that the mean BMI of cesarean section group was significantly higher than those in vaginal delivery group , (P<0.05), which indicated that heavier women were more prone to have cesarean section . On the other hand, distribution of the studied group according to the WHO classification of BMI revealed that normal BMI was less frequent in cesarean section group than vaginally delivered group, while the prevalence of overweight/obesity (BMI > 25 kg/m2) was significantly higher in cesarean than vaginal delivery group, (P<0.05). These findings agreed that reported in previous studies (7,8,33,40). Overweight\Obese women found to be almost 2.6 folds more likely to delivered by cesarean sections than those with normal BMI, overweigh\ obesity in cesarean section group contributed for 59% compared to only 36% in vaginally delivered group with an OR

of 2.6. Our study shows an increased risk of cesarean delivery in pregnant women with obesity, with respect to normal weight, it increases as the BMI increases. These findings highlight the importance of assessing pre-pregnancy weight in all BMI categories, given that a large proportion of pregnant women are overweight or obese.

From other point of view, pre-pregnancy overweight and obesity increases the risks of maternal, neonatal and childhood outcomes (10)

A correct prenatal care, an adequate nutritional classification, the elaboration of a diet and the adequate indications of the health personnel are key points to achieve an adequate diet in the pregnant woman (41,42). Optimal prenatal control of overweight and obesity should begin before conception. Overweight and obese women who manage to lose a little weight before pregnancy may have better obstetric results, and weight loss, diet modifications, exercise, and behavior change during pregnancy should be promoted(43,44). The obstetricians play an important role during pregnancy control, as a health educator and one of its priority interventions is to promote healthy attitudes and habits in the gestational stage.

The limitation of this study was the diagnosis of overweight and obesity, which depends on the recall memory and reported weight and height of the pregnant woman before gestation, so there must be a correct recording of these data in the medical records, for early detection and treatment.

5. CONCLUSIONS

Pregestational overweight and obesity increase the risk of completing a pregnancy by cesarean section more than twice compared to those of normal weight. in pregnant women managed in our hospital. Pregestational overweight and obesity were independent risk factors for the completion of cesarean delivery. We recommend to consider pre-pregnancy overweight and obesity as risk factor for the culmination of pregnancy by cesarean section. Reinforce and strengthen preventive measures: educational workshops, in nutritional programs aimed at women planning pregnancy and pregnant women, to improve diet and lifestyles. Design strategies and intervention measures to reduce risk factors for obesity and overweight.

Ethical Clearance : Ethical clearance and approval of the study are ascertained by the authors. All ethical issues and data collection were in accordance with the World Medical Association Declaration of Helsinki 2013 for ethical issues of researches involving humans, informed consent obtained from all patients. Data and privacy of patients were kept confidentially.

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