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Maternal Anthropometric Characteristics and Fetal Birth Weight as Predictors of Cesarean Delivery in Nulliparous Women, with Singletons Pregnancies in Cephalic Presentation: A Cross Sectional Study

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Author's contributions

This work was carried out in collaboration between all authors. Author MAA performed statistic analysis and wrote the draft. Authors DAR, AOA, HA and AMI Management of patients and data collection at their unit and wrote the protocol and designed the study. Author IA initiated the idea, contributed in analysis, correction of draft. All authors read and approved the final manuscript.

Original Research Article

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ABSTRACT

Background: Globally, the rate of cesarean delivery is increasing rapidly over the past years.
Aim: The study was conducted to investigate the incidence and the predictors for cesarean delivery in nulliparous women at Khartoum Hospital, Sudan.
Methods: A prospective cross-sectional hospital-based study was conducted where all parturient nulliparous women delivered in the period between February to April 2012 were included. Socio-demographic characteristics were gathered through structured questionnaires. Maternal anthropometric measures, birth weight, gender and mode of

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delivery were recorded and compared between those who delivered vaginally and by emergency cesarean delivery.
Results: A total of 533 parturient women were enrolled, of these, 147(27.6%) were emergency cesarean delivery. The cesarean delivery rate in nulliparous increased significantly with increased maternal, age > 30 years (OR=2.4, 95% CI= 1.1─5.2, P= 0.032), decreased maternal height < 150 cm (OR=2.4, 95% CI=1.4─4.1, P=0.002), and in increase BMI ≥ 30 Kg/m 2 (OR=2.2, 95% CI=1.1─4. 9, P=0.046) and increase in birth weight > 3750g (OR=2.7, 95% CI=1.1─6.4, P=0.026). There was no association between cesarean delivery rate, mid-upper arm circumference and fetal gender.
Conclusion: There was a high incidence of cesarean delivery among nulliparous women especially among elder, obese women, short statue women and with a fetal birth weight > 3750g.

Keywords: Nulliparous; cesarean delivery; weight; height; body mass index.

1. INTRODUCTION

The rate of caesarean delivery has increased rapidly in many parts of the world, and now it is one of the most commonly performed operations [1,2]. Much of this increase is due to a sharp rise in primary cesarean delivery rates [3,4]. Previous research has indicated that cesarean delivery compared with vaginal birth is associated with increased maternal and neonatal morbidity and mortality [3].

In order to reduce cesarean delivery in nulliparous that performed due to cephalopelvic disproportion, it is important to screen nulliparous who are at risks of labor complications. Since the first half of the 20th century may measures were used to predict the likelihood of cesarean delivery in nulliparous. Obstetrics examination often included a detailed and intrusive examination to exclude feto-pelvic disproportion. In the past, X-ray pelvimetry and clinical pelvic assessment were used to judge for pelvic adequacy in nulliparous [5]. Nowadays, nulliparous women are subjected to true labor pain to judge for their pelvic adequacy. Maternal anthropometric measurements like height (<150 cm) and weight (BMI) were used to predict the mode of delivery in nulliparous women [6]. Other factors that were used to screen for potential risk of labor complications include, maternal age and shoe size [7]. More recently, feto-pelvic index was used to predict the likelihood of a cesarean delivery due to cephalopelvic disproportion [8]. Nulliparous are at high risks for dysfunctional labor due cephalopelvic disproportion. Early identification of those patients who are at the potential risk of cesarean delivery among nulliparous women is one strategy to reduce maternal and perinatal mortality and morbidity rates. This will be of benefit in communities where personnel and resources are limited. By identifying such individual, it might be possible to distribute the level of care according to patients needs.

A recent report on the incidence of cesarean delivery showed that there was a high cesarean delivery rate (43.2%) at Khartoum Hospital [9]. The present study was conducted to investigate the incidence and the predictors (mainly anthropometrics measurement) for cesarean delivery in nulliparous at Khartoum Hospital, Sudan.

2. METHODS AND SUBJECTS

A prospective cross-sectional hospital-based study was conducted during the period of February to April 2012. A sample of 530 nulliparous women was selected to calculate the proportion of those who delivered by cesarean/vaginally within 3 percentage points of the true proportion, assuming the true proportion was 80% and that 10% of women would not respond. After signing an informed consent, parturient women with term, singleton pregnancy and cephalic fetal presentation were enrolled to the study. The study was primarily designed to focus only on dystocia and other conditions that might be associated with caesarean section in labour (i.e. non reassuring fetal status) had been excluded.Women with elective cesarean section, multiple gestations and major fetal malformations were excluded. Patients who agreed to participate had detailed prenatal record. The data were gathered through questionnaire filled by trained medical officer. Neither the investigators nor the medical officer interfere with decision and the management of the labor which was managed by the hospital team. The gathered data include maternal age, occupation, education and antenatal care utilization. The variables included anthropometric measurements (maternal height, weight, mid-upper arm circumference (MUAC) and birth weight). Maternal weight (kg) and height (cm) were measured expressed as body mass index (BMI - weight (kg)/height (m) ^{2}. The BMI was classified according to Abrams et al. method [10]. The anthropometrics variables used in the analysis of cesarean section rate that were originally continuous were categorized to determine the cut-off points that influence the cesarean delivery rate, Table 1.

Table 1. Definition and categories of variables used in the analysis of cesarean delivery rate is Sudan

Variable	Category
Maternal age, yrs	Originally was continuous variable. Then categorized into 2 age groups; age >30 and ≤30 years
Maternal height, cm	Originally it is continuous variable. Then dived into <150 and .≥ 150 cm
Fetal birth weight(g)	It is continuous variable. In the analysis it was entered as a categorical variable which was categorized into 2 weight groups; >3750 and ≤ 3750g
Antenatal care	Was divided into attendance (reference category) vs. non attendance
Occupation	Were divided into housewives and non housewives (employee)
Education	education level < secondary level (8 year) and ≥ secondary level
Body mass index, kg/ m^2	BMI < 19 as underweight; BMI of 20 - 24.9 were normal BMI; BMI, 25-29.9 as overweight and BMI ≥ 30 were considered obese.

The study was approved by the Ethic Committee of and the Research Board at the Faculty of Medicine, University of Khartoum.

2.1 Statistical Analysis

The Statistical Package for the Social Sciences for Windows, version 16.0 (SPSS Inc., Chicago, Illinois) was used to analyses the data. Means and proportions were compared between women who delivered vaginally and women who delivered via cesarean delivery by student t-test and X^2 respectively. Then univariate and multivariate analysis was performed

where cesarean delivery is the dependent variable and age, height, weight MUAC, and fetal birth weight were the independent variables. Adjusted odds ratios (OR) and the corresponding 95% confidence interval (CI) were estimated. A p value <0.05 was considered significant.

3. RESULTS

A total of 533 nulliparous parturient women were enrolled, 147(27.6%) of them had an emergency cesarean delivery. There was no significant difference between women who delivered vaginally and those who delivered by cesarean in the educational level, utilization of the antenatal care and height. In comparison with women who delivered vaginally, women who delivered by cesarean had significantly a higher age [24.7(4.9) vs. 22.7(4.7) years, p<0.001), BMI [26.8(4.6) vs. 24.7(3.98) kg/m^2, P<0.001) [MUAC [26.8(4.2) vs. 25.5(3.6), cm, P= 0.002 and birth weight [3050.6 (574.4) vs. 2897.7 (510.0) g, P = 0.003, Table 2.

Table 2. Demographic and anthropometrics characteristics in both vaginal and cesarean birth

Characteristics	Vaginal birth (n=386)	Cesarean birth (n=147)	P value
Mean maternal age, yrs	22.7(4.7)	24.7 (4.9)	< 0.001
Maternal weight, cm	62.8 (11.1)	67.41 (3.4)	< 0.001
Maternal height, cm	159.5 (6.9)	158.4 (8.3)	0.117
Body mass index, K/m_2	24.7 (3.98)	26.8 (4.6)	< 0.001
Mid upper arm circumference, cm	25.5 (3.6)	26.8 (4.2)	0.002
Birth weight, g	2897.7 (510.0)	3050.6 (574.4)	0.003
Number (%) of			
Education < secondary level	165 (42.7)	61 (41.5)	0.764
Housewives	355 (92.1)	123 (83.7)	0.004
Antenatal non users	34(8.8)	8(5.4)	0.277
Male gender	194(50.3)	78(53.1)	0.430

In logistic regression, maternal age > 30 years (OR=2.4, 95% CI= 1.1–5.2, P= 0.032), height < 150 cm (OR=2.4, 95% CI=1.4–4.1, P=0.002), BMI ≥ 30 kg/m^2 (OR=2.2, 95% CI=1.1–4. 9, P=0.046) and birth weight >3750 g (OR=2.7, 95% CI=1.1–6.4, P=0.026) were significantly associated with cesarean delivery, Table 3. The housewives, maternal weight, MUAC and overweight were associated with caesarean delivery in univariate analyses only. The associated between the height and cesarean delivery persist even when the age was removed from the model. There was no association between cesarean delivery rate and, education, antenatal care fetal gender, Table 3.

Table 3. Factors associated with increased cesarean delivery, using univariate and multivariate analyses

Variable	Univariate analysis			Multivariate analysis		
	OR	95% CI	P value	OR	95% CI	P value
Maternal age >30 years.	2.5	1.2–5.0	0.011	2.4	1.1–5.2	0.032
Maternal height < 150 cm	4.7	2.2–10.3	<0.001	2.4	1.4–4.1	0.002
Maternal weight	1.12	1.1–1.2	<0.001	1.0	0.9–1.1	0.492
Mid-upper arm circumference	1.1	1.1–1.2	0.002	1.0	0.9–1.1	0.269

Table 3 Continued…….

Fetal birth weight >3750	3.0	1.4–6.4	0.004	2.7	1.1–6.4	0.026
Fetal gender	0.8	0.6 –1.2	0.393	0.8	0.5–1.2	0.233
Education level < secondary	1.1	0.7–1.6	.696	1.4	0.9–2.4	0.132
Housewife	2.3	1.3–4.2	0.006	0.6	0.3–1.3	0.194
No antenatal care attendance	0.6	0.3–1.4	0.231	0.5	0.2–1.5	0.248
Underweight	0.4	0.1–1.3	0.135	0.5	0.2–1.8	0.350
Overweight	1.9	1.2–2.9	0.003	1.3	0.8–2.3	0.302
Obese	3.3	1.8–6.3	<0.001	2.2	1.1–4.9	0.046

4. DISCUSSION

The main findings of the present study were a high incidence (27.6%) of cesarean delivery, especially among elder, shorter, obese women and women who had heavier newborn. Recently a high incidence (43.2%) of cesarean delivery was reported in the same hospital [9]. This high rate of cesarean delivery does not reflect the actual rate at the community where in a national survey (in Sudan); only 8% of deliveries were cesarean deliveries [11]. Generally, cesarean delivery rate above 15% is unnecessarily high as proposed by the World Health Organization and did not result in improvement of neonatal outcomes. In the current study, elder nulliparous women (> 30 years) had 2.4 folds risk to have a cesarean delivery. In a recent observation, maternal age was found to be an independent predictor of cesarean delivery [12,13]. Peipert and BrackenI observed that nulliparous whose age > 30 years had a 70% increase in risk for cesarean delivery compared with nulliparous < 30 years old [13].

In a study that included a total 10,737 consecutive nulliparous women who were managed according to an established Active Management protocol, concluded that prolonged labor (> 12 hr), oxytocin augmentation, instrumental delivery, and cesarean section (indices for dystocia) all were increased progressively with increasing maternal age [14]. There is no satisfactory explanation for this linear association between age and the cesarean section rate. However, pelvic rigidity and over care for premium babies in this group might be a behind this increase. In addition, the biosocial characteristics of women may change over years which may affect the cesarean delivery rates.

In this study shorter women (height < 150 cm) has a 2.5 folds increase in cesarean delivery. This goes with the previously published observations [15,16] which showed that maternal height of < 150 cm is significantly with increased cesarean delivery rate. A cutoff point of 150 cm of height has been used by several investigators [17,18]. Another study was conducted to clarify the relationship between maternal height and cesarean delivery, in which maternal height for women with singleton pregnancies was divided into 4 groups', 153 cm, 156 cm, and 160 cm, concluded that, the incidence of cesarean delivery was a significantly increased for mechanical reasons regardless of the fetal birth weight. This indicates that the effect of maternal height acts as a continuum rather than in a dichotomous manner [19]. In the current study, obese women were 2.2 times more likely to deliver by cesarean. Recently a report from the same hospital showed that obese women of all parity had 3.9 and 4.5 folds risk to deliver by elective cesareans and emergency cesarean, respectively. It is worth to be mentioned that BMI was calculated during labor where there was no data on the BMI before pregnancy. Savitz et al. [20] in their study concluded that prepregnancy weight and weight gain in pregnancy are associated with increased cesarean delivery rate. In the developing countries, it is difficult to obtain pre-pregnancy weight since the majority of our

patients are poor antenatal care attendant. The good predictability of BMI appeared due height alone since it is not changing throughout pregnancy. Previous studies have shown that there was significant association between prepregnancy weight, BMI, gestational weight gain and increase in BMI during pregnancy as risk factors and found a positive association [17]. In a cohort study designed to investigate whether cesarean delivery rates are increased in first and second stages of labor in overweight and obese nulliparous women at term concluded that both overweight and obesity is an independent risk factor for increased cesarean delivery only in the first stage while the second stage of labor did not influence cesarean delivery rates [21].

The current study showed that birth weight > 3750 g (which was obtained after delivery) increased risk of cesarean delivery. A previous study has shown that fetal birth weight is an important predictor of cesarean delivery rate [22]. The diagnosis of actual fetal birth weight is retrospective, and it is used as a predictor for cesarean delivery, moreover, the clinical assessment and ultrasound has a limited predictive value and can lead to unnecessary obstetrical intervention [22]. It a recently published data it has been reported that over half (52.4%) of macrosomic babies were diagnosed retrospectively indicating a limited value of clinical and ultrasound examinations for estimation of the fetal weight [23]. For this reason, fetal birth weight as a predictor of cesarean delivery rate cannot be put into practice since there is no an ideal method for better prediction of fetal weight estimation antenatally.

Our data revealed that, fetal gender is not a predictor of cesarean delivery rate. However, Harlow et al. [24] reported that fetal sex significantly influenced the cesarean delivery rate. The mechanism whereby fetal sex affect the cesarean delivery rate remain unclear, some suggest increase production of corticosteroids by fetus which lead to more disposition of adipose tissues in fetal subcutaneous tissues.

In the current study, mid upper arm circumference (MUAC) was found to be insignificant predictor of cesarean delivery rate on the basis of multivariate analysis. Previous studies have shown that (MUAC) well correlated with an increase in cesarean delivery rate. The best ability of MUAC to predict fetal birth weight is by combining the volumetric measurements (abdomen, volume of upper arms, and thigh) with two-dimensional measurements [25,26]. One of the limitations of the current study is its inability (out of the objectives) to investigate the process of the labour itself. The study was designed just to record the desired outcomes. There was no interference with the decision of the delivery itself which was " failure- to – progress". The two terms "prolonged/obstructed labor and cephalopelvic disproportion were the most frequent indications for cesareans in Sub-Saharan Africa [27,28]. Unfortunately, it seems that there was no standard classification system for cesarean indications and can be different in various settings [29, 30]. In most of Sub-Saharan Africa, the cesareans were decided with inappropriate indications or when the indications were unclear [31].

There is a dramatic increase in cesarean delivery rate worldwide. Unfortunately, this increase in cesarean delivery rates is not associated with improvements in neonatal outcomes [32]. To maintain an acceptable caesarean section rate, Robson et al. [33] suggested a Multidisciplinary Quality Assurance Program in each delivery unit; additionally cesarean delivery rate should not be considered in isolation from other outcomes. Moreover, a Joint workshop of Eunice Kennedy Shriver National Institute of Child Health and Human Development, Society for Maternal-Fetal Medicine, and American College of Obstetricians and Gynecologists [34] addressed the concept of preventing the first cesarean. The workshop addressed essential issues particularly those concerning definition of common indications for cesarean delivery such as "failed induction" and "arrest of labor progress".

Authors recommended that health caregivers should get adherent to appropriate definitions and enough time should be given before establishing the diagnosis of these indications. Furthermore, the threat of lawsuits may be one reason for a high threshold for performing CS. Absolute indications for CS are few, with the majority of these indications are subjective.

It is worth to be mentioned that maternal age (as results of education) might have increased, and this influenced of the rate of Cesarean section. Furthermore, cesarean delivery rate may be influence by other factors e.g. the presence of pregnancy induced hypertension, epidural anesthesia.

The shortcomings of this report are the limited number of cases recruited, the gathering of the data from a single center rather multicenter (the later may be more representative of the general population) and its inability (out of the objectives) to investigate the process of the labor itself. The study was designed just to record the desired outcomes.

5. CONCLUSION

There was a high incidence of cesarean delivery among nulliparous women especially among elder, obese women, short statue women and with a fetal birth weight > 3750g. Given these facts, nulliparous women who are at potential risk of cesarean delivery should have special care during labor especially in communities where personnel and resources are limited. This will minimized the potential risks associated with cesarean delivery for both fetus and mother.

CONSENT

All authors declare that ‘written informed consent was obtained from each patient for publication of this case report.

ETHICAL APPROVAL

All authors hereby declare that all experiments have been examined and approved by the appropriate ethics committee and have therefore been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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