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Prevalence and Adverse Pregnancy Outcomes Associated with Maternal Obesity in the Bamenda Regional Hospital

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Abstract

Introduction: Obesity is one of the most common problems of reproductive age women and has been associated with diverse adverse pregnancy outcomes. Its prevalence in pregnancy is estimated at 14% in Cameroon. **Objective:** The main objective of this study was to determine the adverse pregnancy outcomes associated with obesity in the Regional Hospital Bamenda. **Methodology:** This was a hospital-based cross-sectional study. We recruited 283 participants and their BMIs were used to classify them as underweight (<18.5), normal weight (18.5 - 24.9), overweight (25 - 29.9) and obese (≥30). Ethical clearance, administrative authorisation and consent of participants were obtained. Data was collected using a pretested questionnaire. We collected data on sociodemographic characteristics, anthropometric characteristics, and adverse pregnancy outcomes. Data was analysed using Microsoft Excel version 2010. Fisher's test was used to determine relative risk on bivariate logistic regression. P-values < 0.05 were considered statistically significant. **Results:** Most participants were in the age group 20 - 34 years, and were multigravida and multipara. The prevalence of maternal obesity was 31.4%. Obesity was associated with an increased risk of hypertensive disorders [RR: 7.7, 95% CI (2.13 - 42.39), p = 0.0003], caesarean section [RR: 2.9, 95% CI (1.11 - 4.01), p = 0.017] and macrosomia [RR: 7.3, 95% CI (3.03 - 19.61), p < 0.0001]. **Conclusion:** Maternal obesity is associated with hypertensive disorders, caesarean section and macrosomia.

Keywords

Maternal, Obesity, Pregnancy, Outcome

1. Introduction

Obesity is defined by the World Health Organization as an excessive or abnormal accumulation of fat that carries a risk to health [1]. It is measured using several parameters such as the Body Mass Index (BMI), the waist circumference, waist/hip ratio, skin fold thickness and percentage of body fat [2].

Obesity is one of the most common health problems of reproductive age women [3] and its prevalence is increasing worldwide [4]. It is estimated that 1.9 billion adults are overweight; with over 650 million being obese, and women are more affected [1]. In Africa, a prevalence of 4.5% to 50.2% was reported in 2021 with a higher prevalence in the northern and southern parts of Africa [5]. The prevalence increases with maternal age and parity [6]. Similar trends have been reported in Cameroon, with the prevalence of obesity reported at 15.1% in the general population, females more obese than males, and urban population more affected than rural populations [7].

The main factors responsible for obesity are sedentary lifestyle, increased dietary fat intake and genetic factors [2]. Other risk factors include socio-demographic factors such as a low socio-economic status (which is implicated in all forms of malnutrition), older age, urban settlement, higher level of education, easy access to junk food and multiparity [8].

Obesity is known to adversely affect the course and outcome of pregnancy for both the mother and the neonate. Maternal adverse effects include gestational diabetes [6] [9] [10] [11], pre-eclampsia/eclampsia and gestational high blood pressure [4] [6] [11], labour induction often with failure [12], longer duration of labour [12] [13], caesarean delivery [3] [4] [6] [12] [14] [15] [16], episiotomies and genital tears [17] and postpartum haemorrhage [18] [19]. The neonatal effects are preterm deliveries, foetal macrosomia, stillbirths, low Apgar scores and perinatal deaths [20].

Several interventions have been investigated as possible solutions to the problem such as physical exercise, dietary changes and drugs. Drugs such as metformin showed no benefit in this light [21] while physical exercise at least 30 minutes daily for a minimum of three times a week alongside an increase in fiber intake were associated with weight reduction [21] [22] [23]. However, this weight reduction was found to be insignificant during pregnancy and this was linked to non-compliance to lifestyle prescriptions and a lack of knowledge on the importance of adequate gestational weight gain (GWG) [21] [22]. For this reason, maternal obesity and excessive GWG continue to be on the rise despite these interventions. Women with pre-pregnancy obesity are advised to gain a narrow range of weight (5 - 9 kg) in order to minimise adverse outcomes [24].

Current guidelines recommend that women apply these measures before conception to attain a normal BMI, and the same measures be applied during pregnancy to minimise excessive weight gain [1] [21] [22] [24].

With the rising prevalence of obesity amongst reproductive age women, the obesity-related obstetric complications could equally be on the rise and insights into the problem can go a long way to reduce maternal morbidity and mortality. We therefore had as aim to determine the prevalence and adverse obstetrical outcomes associated with maternal obesity in the antenatal clinic of the Regional Hospital Bamenda (RHB).

2. Materials and Methods

2.1. Study Design and Study Setting

This was a cross-sectional study conducted in the RHB from March to May 2022. Bamenda is the capital city of the North West Region. The RHB is a category 3 level hospital found in the Bamenda Health District. The Obstetric and Gynaecologic service is one of the departments of this hospital and receives patients referred from various hospitals and health centers.

2.2. Study Population and Sample

The study population was made of all women who delivered in the RHB during the study period. We approached and gave information about the study to all the women who had delivered in the RHB during the study period. We included in the study women with documented weights before 12 weeks of gestation and who gave their informed consent to participate in the study. We excluded patients with a chronic disease before pregnancy (hypertension, diabetes mellitus, cardiac disease, renal disease, sickle cell disease) and any patient with a significant psychiatric disorder that could impair an interview (such as schizophrenia, delirium, dementia, post-partum psychosis).

2.3. Sample Size Calculation and Sampling Technique

Using a prevalence of pre-pregnancy obesity of 14.7% [14], the minimum required sample size was calculated at 193 participants using the Cochran's formula. A consecutive selection of every accessible client who met the inclusion criteria over the study period was done.

2.4. Study Procedure

Before the start of this study, ethical clearance was obtained from the institutional review board of the University of Bamenda (No 2022/0393H/UBa/IRB). Administrative authorization was obtained from the Regional Delegate of Public Health for the North West Region and the Director of the RHB. All participants were individually contacted in the wards where postpartum cases are hospitalised. We explained the study to each participant, in order to obtain informed and signed consent. After the consent, we explained to the participants to be ex-

cluded why we believe that they could not participate in the study.

2.5. Data Collection

We collected data using an interviewer-administered questionnaire designed for the study. This questionnaire was pretested from the target population before the start of the study to check for clarity, validity and reliability. The following variables were of interest in our study: Sociodemographic and obstetrical data: (age, marital status, level of education, occupation gravidity, parity), anthropometric data (first trimester weight which was obtained by consulting records such as the ANC card or hospital book, height which was measured using a stadiometer or obtained from the ANC card and BMI was calculated by dividing the weight by the square of height), pathologies during pregnancy (gestational diabetes mellitus, gestational hypertension, pre-eclampsia/eclampsia), outcome of pregnancy (onset of labor, gestational age at delivery, mode of delivery, episiotomy or occurrence of a perineal tear, neonatal birth weight, Apgar score, stillbirth, nursery admission).

2.6. Data Management

Data was analysed using the Statistical Package for the Social Sciences, SPSS version 27.0.1. Body mass indices were used to classify participants as underweight, normal weight, overweight and obese. Percentages were used to describe the prevalence of obesity in the study population. Descriptive data was presented as frequencies and percentages. Data was then filtered to include only those who were obese or normal weight. Fisher's test was used to calculate relative risks of having an adverse outcome on bivariate analysis in order to determine association between obesity and pregnancy outcome and p values < 0.05 were considered statistically significant.

3. Results

A total of 298 women were approached and invited to participate in this study. Amongst these, 4 did not give consent and 11 were excluded because of chronic diseases (chronic hypertension, sickle cell anemia and diabetes mellitus). We therefore included 283 participants for analysis.

3.1. Sociodemographic and Obstetrical Characteristics of Study Population

The mean age of the participants was 28.04 ± 5.90 years with range 14 to 43 years. The majority of participants were in the age group 20 - 34 years (n = 220, 77.7%), were married or cohabiting (n = 227, 80.2%), had a secondary level of education (n = 138, 48.8%), were self-employed (n = 164, 58%), were multigravida (n = 214, 75.6%) and were multipara (n = 130, 45.9%). See Table 1.

3.2. Anthropometric Characteristics of the Study Population

The body mass index of the study participants ranged from 17.6 to 53.9 kg/m^2

Table 1. Sociodemographic and obstetrical characteristics of the study population (n = 283).

Variable	Categories	Frequency	
		N	%
Age	<20	16	5.7
	20 - 34	220	77.7
	≥35	47	16.6
Marital status	Single	52	18.4
	Married/cohabiting	227	80.2
	Divorced/separated	03	1.1
	Widow	01	0.3
Education	No formal Education	0	0.0
	Primary Education	12	4.2
	Secondary Education	138	48.8
	University education	133	47
Occupation	Student	62	21.9
	Employed	57	20.1
	Self employed	164	58
Gravidity	Primigravida	69	24.4
	Multigravida	214	75.6
Parity	Primipara	83	29.3
	Multipara	130	45.9
	Grand multipara	70	24.8

Employed (teacher, accountant, nurse, secretary); self-employed (Farmer, seamstress, hairdresser, business, housewife).

with an average BMI ± SD of 27.9 ± 5.2 kg/m^2. Out of the 283 participants, 89 were obese giving a prevalence of 31.4%. Amongst the obese population, 66 (74.2%) had class I obesity accounting for 23.3% of the total population, 17 (19.1%) had grade II obesity making up 6% of total population and 6 (6.7%) were morbidly obese, constituting 2.1% of the total population. See Figure 1.

3.3. Adverse Maternal Outcomes

The prevalence of hypertensive disorder was 8.1% (n = 23) of participants with majority being preeclampsia. Gestational diabetes had a prevalence of 0.7% (n = 2), with all two cases occurring in the obese group. The majority of participants had spontaneous onset of labour (n = 241, 85.2%), and delivered vaginally (n = 186, 65.7%). Amongst those who had a postpartum complication, perineal tears were the most common, occurring in 16.7% of those who had vaginal delivery. Caesarean section was the most common adverse outcome occurring in 34.3% (n =

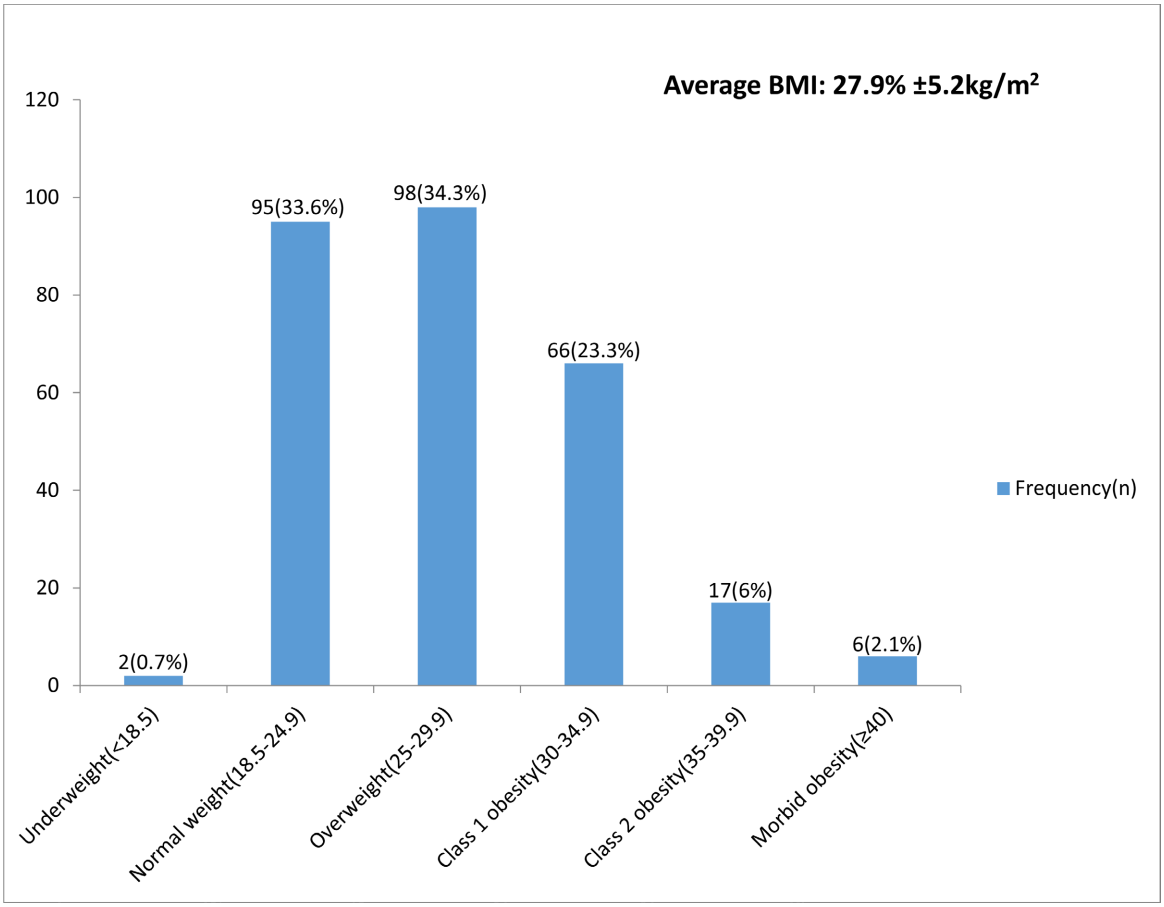

Figure 1. Distribution of the sample population according to body mass index.

97) of the population with a prevalence of 43.8% and 21.1% in the obese and normal weight groups respectively. See Table 2.

After bivariate analysis, maternal obesity was found to be associated with increased risk of hypertensive disorders [RR: 7.7, 95% CI (2.13 - 42.39), p = 0.0003] and increased risk of caesarean section [RR: 2.9, 95% CI (1.11 - 4.01), p = 0.017] compared to women with normal weight. There was no statistically significant difference for gestational diabetes, labour induction, perineal tear, cervical tear, episiotomy, endometritis, surgical site infection and post-partum hemorrhage. See Table 3.

3.4. Adverse Neonatal Outcomes

The majority of babies were delivered at term (n = 258, 91.2%). Most neonates (n = 150, 53.1%) had a normal birth weight while 18.7% (n = 53) were macrosomic. Most (n = 275, 97.2%) of the neonates had an Apgar score of ≥7 in the 5th minute. The prevalence of early neonatal death was 2.2% (n = 6). Thirty-two (11.3%) neonates were admitted in the nursery, with prematurity being the most common reason for admission. See Table 4.

On bivariate analysis, obesity was found to be associated with macrosomia [RR: 7.3, 95% CI (3.03 - 19.61), p < 0.0001] compared to women with normal

Table 2. Distribution of adverse maternal outcomes of pregnancy according to BMI.

Maternal outcome		Underweight (N = 2) n (%)	Normal weight (N = 95) n (%)	Overweight (N = 97) n (%)	Obese (N = 89) n (%)	Total (N = 283) n (%)
Hypertensive disorder	GHTN	00 (0)	01 (1.1)	05 (5.3)	04 (4.5)	10 (3.5)
	Pre/eclampsia	00 (0)	02 (2.1)	04 (4.1)	07 (7.9)	13 (4.6)
	None	02 (100)	92 (96.8)	88 (90.6)	78 (87.6)	260 (91.9)
GDM	Present	00 (0)	00 (0)	00 (0)	02 (2.2)	02 (0.7)
	Absent	02 (100)	95 (100)	97 (100)	87 (97.8)	281 (99.3)
Labour induction	Yes	00 (0)	12 (12.6)	18 (18.6)	12 (13.5)	42 (14.8)
	No	02 (100)	83 (87.4)	79 (81.4)	77 (86.5)	241 (85.2)
CS	Yes	00 (0)	20 (21.1)	38 (39.2)	39 (43.8)	97 (34.3)
	No	02 (100)	75 (78.9)	59 (60.8)	50 (56.2)	186 (65.7)
Perineal tear	Yes	-	13 (13.7)	14 (14.4)	04 (4.5)	31 (10.9)**
	No	-	62 (86.3)	45 (85.6)	46 (95.5)	155 (89.1)
Cervical tear	Yes	-	02 (2.1)	00 (0)	00 (0)	02 (0.7) **
	No	-	73 (97.9)	59 (100)	50 (100)	184 (99.3)
Episiotomy	Yes	-	06 (6.3)	03 (3.1)	02 (2.2)	11 (3.8) **
	No	-	69 (93.7)	56 (96.9)	48 (97.8)	175 (96.2)
Endometritis	Yes	00 (0)	02 (2.1)	02 (2.1)	03 (3.4)	07 (2.5)
	No	02 (100)	93 (97.9)	95 (97.9)	86 (96.6)	276 (97.5)
Surgical site infection	Yes	00 (0)	1 (1.1)	02 (2.1)	05 (5.6)	09 (3.2)
	No	02 (100)	94 (98.9)	95 (97.9)	84 (94.4)	274 (96.8)
Postpartum hemorrhage	Yes	00 (0)	03 (3.2)	02 (2.1)	01 (1.1)	06 (2.1)
	No	02 (100)	92 (96.8)	95 (97.9)	88 (98.9)	276 (97.9)

(GHTN = gestational hypertension, GDM = gestational diabetes mellitus, CS = Caesarean section). **N = 186 because perineal tears, cervical tears and episiotomies were expressed as a fraction of those who had a vaginal delivery.

Table 3. Comparison of adverse maternal outcomes between the normal weight and the obese groups.

Maternal outcome		Obese (N = 89) n (%)	Normal weight (N = 95) n (%)	RR (95% CI)	p values
Hypertensive disorder	Yes	18 (20.2)	03 (3.2)	7.70 (2.13 - 42.39)	0.0003**
	No	71 (79.8)	92 (96.8)		
GDM	Yes	02 (2.2)	00 (0)	0.00 (0.00 - 4.98)	0.233
	No	87 (97.8)	95 (100)		
Labour induction	Yes	16 (18)	12 (12.6)	1.51 (0.62 - 3.75)	0.412
	No	73 (82)	83 (87.4)		
CS	Yes	39 (43.8)	20 (21.1)	2.91 (1.11 - 4.01)	0.017**
	No	50 (56.2)	75 (78.9)		

Continued

Perineal tear	Yes	04 (4.5)	13 (13.7)	0.30 (0.07 - 1.02)	0.041
	No	85 (95.5)	82 (86.3)		
Cervical tear	Yes	00 (0)	02 (2.1)	0.00 (0.00 - 5.68)	0.498
	No	89 (100)	93 (97.9)		
Episiotomy	Yes	01 (1.2)	06 (6.3)	0.17 (0.003 - 1.44)	0.119
	No	88 (98.8)	89 (93.7)		
Endometritis	Yes	03 (3.4)	02 (2.1)	1.62 (0.18 - 9.79)	0.674
	No	86 (96.6)	93 (97.9)		
Surgical site infection	Yes	05 (5.6)	01 (1.1)	5.55 (0.60 - 67.04)	0.109
	No	84 (94.4)	94 (98.9)		
Postpartum hemorrhage	Yes	01 (1.2)	01 (1.1)	1.07 (0.01 - 84.68)	1
	No	88 (98.8)	94 (98.9)		

(GHTN = gestational hypertension, GDM = gestational diabetes mellitus, CS = Caesarean section, ** = statistically significant associations), Fischer's exact test.

Table 4. Frequency distribution table of neonatal outcomes according to various BMI classes.

Neonatal outcome		Underweight (N = 2) n (%)	Normal weight (N = 95) n (%)	Overweight (N = 97) n (%)	Obese (N = 89) n (%)	Total (N = 283) n (%)
GAD	Preterm	00 (0)	05 (5.3)	05 (5.1)	07 (7.9)	17 (6)
	Term	02 (100)	86 (90.5)	90 (92.8)	80 (89.8)	258 (91.2)
	Post term	00 (0)	04 (4.2)	02 (2.1)	02 (2.3)	08 (2.8)
Birth weight	LBW	01 (50)	4 (4.2)	07 (7.1)	09 (10.2)	21 (7.4)
	Normal	01 (50)	74 (77.9)	48 (48.9)	27 (30.7)	150 (53.1)
	Big baby	00 (0)	14 (14.7)	28 (28.6)	17 (19.3)	59 (20.8)
	Macrosomia	00 (0)	03 (3.2)	14 (14.4)	36 (40.4)	53 (18.7)
Stillbirth	Yes	00 (0)	01 (1.1)	01 (1)	02 (2.3)	04 (1.4)
	No	02 (100)	94 (98.9)	96 (99)	87 (97.7)	279 (98.6)
5^{th} Min APGAR	<7	00 (0)	03 (3.2)	03 (3.1)	02 (2.3)	08 (2.8)
	≥7	02 (100)	92 (96.8)	94 (96.9)	87 (97.7)	275 (97.2)
Nursery Admission	Yes	01 (50)	07 (7.4)	10 (10.2)	14 (15.9)	32 (11.3)
	No	01 (50)	88 (92.6)	87 (89.8)	75 (84.1)	251 (88.7)
Reason for admission	Asphyxia	00 (0)	01 (14.3)	02 (20)	02 (14.3)	05 (16.7)
	Prematurity/LBW	00 (0)	04 (57.1)	04 (40)	07 (50)	15 (45.8)
	NNI	01 (100)	00 (0)	02 (20)	01 (7.1)	04 (12.5)
		00 (0)	02 (28.6)	02 (20)	04 (28.6)	08 (25)
Early Neonatal death	Yes	00 (0)	02 (2.1)	01 (1.1)	03 (3.4)	06 (2.2)
	No	02 (100)	93 (97.9)	96 (98.9)	86 (96.6)	277 (97.8)

(GAD = gestational age at delivery, LBW = low birth weight, NNI = neonatal infection, N = total number of participants for each BMI class).

weight. There was no statistically significant difference for stillbirth, Apgar score < 7, admission in the nursery and early neonatal death. See Table 5.

Table 5. Comparison of adverse neonatal outcomes between the obese and normal weight.

Neonatal outcome		Obese (N = 89) n (%)	Normal weight (N = 95) n (%)	RR (95% CI)	p values
GAD	Preterm	07 (7.9)	05 (5.3)	1.07 (0.36 - 3.23)	1
	Term	80 (92.1)	86 (94.7)		
Macrosomia	Yes	36 (40.4)	08 (8.4)	7.30 (3.03 - 19.61)	<0.0001**
	No	53 (59.6)	87 (91.6)		
Stillbirth	Yes	00 (0)	01 (1.1)	00 (00 - 41.63)	1
	No	89 (100)	94 (98.9)		
5th Min APGAR	<7	02 (2.2)	03 (3.2)	0.71 (0.06 - 6.32)	1
	≥7	87 (97.8)	92 (96.8)		
Nursery Admission	Yes	14 (15.7)	07 (7.4)	1.70 (0.60 - 5.25)	0.3526
	No	75 (84.3)	88 (92.6)		
Early Neonatal Death	Yes	04 (4.5)	03 (3.2)	1.44 (0.24 - 10.12)	0.7136
	No	85 (95.5)	92 (96.8)		

(GAD = gestational age at delivery, RR = relative risk, CI = confidence interval) ** = statistically significant associations, Fischer's exact test.

4. Discussion

Obesity is a fast growing public health problem worldwide and this is related to an increase in morbidity in the general population as well as an increase in adverse obstetrical outcomes. There have been varied findings from studies done on maternal obesity and obstetrical outcomes. This study showed that maternal obesity can be associated with some adverse maternal and foetal outcomes.

In our study, the majority of participants (77.7%) were in the age group 20 - 34 years. This is consistent with findings from previous studies in Cameroon. Foeulefack *et al.* in 2015 found that 79% of reproductive age women were in the age range 20 - 34 years [10] while Halle *et al.* in 2018 reported that 60.8% fell in the age group 25 - 34 [14]. The greater proportion of mothers in this age group can be explained by the fact that at this age most women are married or cohabiting and are either not pursuing further education or are better adapted to support the demands of motherhood or education with support from partners [14].

The prevalence of maternal obesity in our sample was 31.4%, which is similar to 29.8% reported by Gaudet *et al.* in Mexico [25] and 30.6% reported by Nurul *et al.* in Malaysia [26]. Our finding also falls within the range 4.5% - 32.5% in Africa as described by Olubusola *et al.* in 2021 [5]. This is however higher than 14% and 14.6% reported for urban Cameroon in 2015 and 2018 respectively [10] [14]. From the above findings, there seem to be a rise in maternal obesity over the years as predicted by WHO [1] and this change can be attributed to a change

in eating patterns, and lifestyle habits which play a big role in weight gain.

The prevalence of hypertensive disorders of pregnancy was found to be 8.1% in our study population, which is lower than 14.5% reported by Nkem *et al.* [27] in the Mezam Division, North West Region of Cameroon. The CDC has reported a value of 15.9% in the USA [28]. This lower value in our study could be explained by the fact that we excluded patients with chronic hypertension during the selection process.

Hypertensive disorder of pregnancy was found to be associated with obesity in our study which is similar to the findings of the meta-analysis of data in African countries [6] and studies conducted, in Brazil [11], India [4] and Lithuania [15]. This however contrasts the findings of Halle *et al.* in 2018 [14]. The difference might be because, in their study, adverse outcomes in the obese group were compared with the outcomes in the non-obese group with overweight women inclusive. Key interventions are necessary to reduce the risk of hypertensive complications as the rate of maternal obesity in the population continues to increase over the years.

Caesarean section was the most common adverse outcome observed in our study, with a prevalence of 34.3%. This is similar to the findings of Halle *et al.* who described caesarean section equally as the most common adverse outcome but with a lower prevalence [14]. Our prevalence is also higher than that described by Dikete *et al.* for Sub-Saharan Africa of 19% [29]. This higher prevalence in our study might be due to increased use of the electronic fetal monitoring and increased diagnosis of non-reassuring fetal heart tones in our setting. Cautious use and interpretation of the electronic foetal monitoring findings is necessary.

The association between obesity and caesarean section is the most common adverse maternal outcome described by studies on this subject. The strong association of obesity and caesarean section is due to the fact that obesity seems to be at the root of several comorbidities. For example, the occurrence of hypertensive disorders in participants with a primary caesarean section made trial of scar unsuitable and thereby further increasing caesarean section rates. Moreover, though not statistically significant, obese participants were more likely to be induced, with failure of induction being another reason for increased CS rates. In our study, 14.8% of our sample had labour induction which is higher than the prevalence of 4.4% reported by Fawole *et al.* as an average rate in Africa with a range of 1.6% to 6.8% [30]. This higher prevalence observed in our study could be explained by the difference in the study period, and the fact that our study setting was a referral center, and more likely to receive patients referred for obstetric conditions that may warrant induction of labour.

The only significant adverse neonatal outcome was macrosomia (18.7%). This is higher than 7.54% reported by Adungna *et al.* in Ethiopia [31]. This difference could be explained by the higher prevalence of obesity in our study.

Maternal obesity has a significant impact on foetal growth. Macrosomia was the only adverse neonatal outcome associated with obesity. Nguefack *et al.* de-

scribed this association in Dschang [9], and a meta-analysis for several African countries [27] had a similar finding. Foetal macrosomia is strongly associated with maternal obesity due to increased insulin resistance even in women without overt diabetes that results in higher levels of foetal glucose and insulin [32]. Another explanation is an increased activity of placenta lipase in the obese pregnant woman, which metabolizes triglycerides and allows the transfer of excess fatty acids to the foetus. The control of weight gains as well as staying active during pregnancy could help prevent the occurrence of macrosomia in the obese population.

Strengths and Limitations of This Study

- Since all the women did not consult in the same unit for their booking ANC visits, slight differences in scales might have affected the weights measured in the first trimester.
- However, this study is the first of its kind in the North West Region of Cameroon.

5. Conclusion

The prevalence of maternal obesity in the Regional Hospital Bamenda is higher than other national values. Hypertensive disorders of pregnancy, caesarean section and macrosomia were adverse outcomes associated with maternal obesity. Prevention of pre-pregnancy obesity prior to conception could help reduce maternal obesity and the associated adverse obstetrical outcomes.

Ethics Approval

Ethical clearance was obtained from the Institutional Review Board of the Faculty of Health Sciences of the University of Bamenda and administrative authorizations were obtained from the Administration of the Regional Hospital Bamenda.

Consent for Publication: Not Applicable

Availability of data and materials: The datasets used and/or analysed during the current study are available from the corresponding author on a reasonable request.

Authors' Contributions

DWP, NE and DJS were involved in the design of the study, and drafted the protocol. All the authors analysed the data, drafted and finalized the manuscript for publication. All authors contributed to the writing of the paper and have approved the final version.

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pate in the study, without which this research would not be possible.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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Questionnaire

SECTION A: DEMOGRAPHIC DATA

S/N	VARIABLE	POSSIBLE RESPONSES	RESPONSE
01	Age (in years)	Any two digit number	
02	Gravid formula		
03	Marital status	Single = 1, Married = 2, cohabiting = 3, Divorced = 4, Widow = 5	
04	Level of education	No formal education = 1, Primary education = 2 Secondary education = 3, University education = 4	
05	Occupation		

SECTION B: ANTHROPOMETRIC MEASURES

S/N	VARIABLE	VALUE
06	Weight (first trimester) in (Kg)	
07	Height in (m)	
08	Weight at delivery in Kg	
09	Weight gain in pregnancy	
10	First trimester BMI in (Kg/m^2)	

SECTION C: MATERNAL OUTCOMES

S/N	VARIABLE	POSSIBLE RESPONSE	RESPONSE
11	Hypertensive disorder in pregnancy	None = 0, Gestational HTN = 1 Preeclampsia/eclampsia = 2	
12	Gestational Diabetes mellitus	Present = 1 absent = 2	
13	Labour onset	Spontaneous = 1 Induced = 2	
14	Duration of active labour		
15	Mode of delivery	Vagina delivery = 1 Instrumental delivery = 2 Caesarean section = 3 Indication of caesarean Section	
16	Episiotomy	Yes = 1 No = 2	
17	Perineal tear	Yes = 1 No = 2	
18	Cervical tear	Yes = 1 No = 2	
19	Postpartum complication	None = 0, Endometritis = 1 Surgical site infection = 2 Deep vein thrombosis = 3 Postpartum hemorrhage = 4 Mastitis = 5, Maternal mortality = 6	

SECTION D: NEONATAL OUTCOME

S/N	VARIABLE	POSSIBLE RESPONSE	RESPONSE
20	Age at delivery (weeks)	28 - 36 + 6 days = 1, 37 - 41+ 6 days = 2, ≥42 = 3	
21	Number of babies		
22	Fetal length in cm		
23	Birth weight in Kg	<2.5 = 1, 2.5 - 3.4 = 2, 3.5 - 3.9 = 3, ≥4 = 4	
24	Sex of neonate	Male = 1 Female = 2	
25	State of newborn	Alive = 1 Stillbirth = 2	
26	APGAR score at the 5th min	<7 = 1 ≥7 = 2	
27	Nursery admission	Yes = 1 No = 2	
28	Reason for admission		
29	Early neonatal death	Yes = 1 No = 2	