

Outcome of Pregnancy in Patients with Excessive Gestational Weight Gain in Two District Hospitals in Douala, Cameroon

Gregory E Halle-Ekane^{1*}, Jacqueline Bih Nsom², Julius Atashili³, John N Palle⁴, Dickson S Nsagha⁵, Charlotte Tchente Nguetack⁶ and Phillip Nana Njotang⁷

¹Department of Surgery and Obstetrics/Gynecology, University of Buea, Cameroon

²Department of Obstetrics and Gynecology, Buea Regional Hospital, Cameroon

³Department of Public Health and Hygiene, University of Buea, Cameroon

⁴Department of Nursing, University of Buea, Cameroon

⁵Department of Public Health and Hygiene, University of Buea, Cameroon

⁶Faculty of Medicine and Pharmaceutical Sciences, University of Douala, Cameroon

⁷Faculty of Medicine and Biomedical Sciences, University of Yaoundé, Cameroon

Article Information

Received date: Jul 15, 2015
Accepted date: Sep 10, 2015
Published date: Oct 09, 2015

*Corresponding author

Gregory Edie Halle Ekane, University of Buea, Cameroon,
Tel: +(237) 699934402,
Email: hallegregory@yahoo.fr

Distributed under Creative Commons CC-BY 4.0

Keywords Gestational; Weight gain; Pregnancy; Outcomes; Douala

Abbreviations ACOG: The American College of Obstetricians and Gynecologists; AGA: Appropriate for Gestational Age; BMI: Body Mass Index; CI: Confidence Interval; GWG: Gestational Weight Gain; IOM: Institute of Medicine; IUFD: Intra-Uterine Fetal Death; Kg: Kilograms; LGA: Large for Gestational Age; PI: Principal Investigator; SGA: Small for Gestational Age; WHO: World Health Organization

Abstract

Introduction: A great proportion of women are gaining weight excessively during pregnancy. This has been shown to have deleterious effects on the mother and the fetus. The aim of this study was to determine the prevalence of excessive gestational weight gain, its risk factors, socio-obstetrical profile of women with excessive gestational weight gain and its pregnancy outcomes.

Methodology: This was a descriptive, cross-sectional study. Data was collected using an interviewer-administered questionnaire. Pre-pregnancy body mass index and gestational weight gain were calculated. Based on the gestational weight gain, participants were classified according to the IOM 2009 guidelines into three groups: less than recommended, recommended, and more than recommended gestational weight gain. Maternal and fetal outcomes were recorded. The data was analyzed with Epi Info™ 7.1.4.0. Proportions were compared using Chi-Squared or Fisher's test. P-values were considered statistically significant if less than 0.05.

Results: The prevalence of excessive gestational weight was 30.6%. It was associated with maternal obesity without an increase rate of Caesarean births ($p=0.98$). Excessive gestational weight gain increased the rates of hypertensive disorders in pregnancy ($p=0.001$) and macrosomia ($p=0.04$).

Conclusion: Maternal obesity and excessive gestational weight gain are associated with adverse pregnancy outcome.

Introduction

The prevalence of overweight and obesity is rapidly increasing world-wide [1] and represents an important risk factor for various diseases [2]. As the prevalence of obesity increases in the general population, so too it is in women of reproductive age [3], and a greater percentage of these women are either entering pregnancy overweight or obese, or are gaining too much weight during pregnancy [4]. In the United States, the Center for Disease Control and Prevention (CDC) reports the prevalence of obesity and overweight in women of reproductive age as 30.2% and 56.7% respectively [3]. Another study conducted in four urban towns in Cameroon in 2006 revealed the prevalence of obesity and overweight to be 25% for men and 50% for women, with 6.5% men and 19.5% women obese [5]. The highest prevalence was recorded amongst the age group of 35 years and above [2]. Overweight and obesity have been reported as the fifth leading risk for global deaths, and at least 2.8 million adults die each year as a result of overweight or obesity [6]. In addition, increasing burden of certain diseases such as diabetes, certain cancers, ischemic heart disease and cardiovascular diseases is attributable to overweight and obesity [5,6]. A study conducted by Mbella in 2002 [7] revealed that 60% of Cameroonian women are obese and at risk of suffering from cardiovascular complications. Overweight and obesity therefore present a great challenge to healthcare professionals especially those providing care during pregnancy.

Maternal obesity and excessive gestational weight gain are strongly associated with a continuum of risk for the mother, fetus, and neonate [3,8-10]. Inadequate GWG is associated with intrauterine growth restriction, preterm delivery [11,12] and higher rates of infant morbidity and mortality [13]. Excessive GWG is associated with increased rate of cesarean delivery, still birth, macrosomia, and traumatic birth injury [9-12,14,15]. Most infants of women with excessive GWG are more likely to have increased adiposity, insulin resistance and can be at risk for subsequent obesity, high blood

pressure and type 2 diabetes [12,15,16]. Some socio-demographic, behavioral and genetic factors predispose to excessive weight gain during pregnancy [2,17,18].

The United States of America Institute of Medicine (IOM) defines weight gain during pregnancy as the difference between the highest weight gained during pregnancy and the pre-pregnancy weight [4]. It proposes guidelines on different ranges of weight to be gained during pregnancy in relation to the pre-pregnancy BMI range according to WHO cut-off points, and categorizes GWG into three categories: insufficient, recommended, and excessive GWG [1].

Despite the rising prevalence of obesity and its associated adverse effects worldwide, in Cameroon, there is little data on the prevalence of obesity and GWG and their impact on pregnancy. Furthermore, factors that have been found in other studies to be associated with pre-pregnancy obesity and GWG [5,17-21] have not been assessed in a few published studies in Cameroon [8-10].

Pre-pregnancy maternal obesity and overweight, as well as excessive GWG, have all been shown by various studies to have adverse effects to varying degrees on the maternal and fetal outcomes of pregnancy [8-10,20,21]. However, despite the high maternal and fetal morbidity and mortality in Cameroon [10], the contributory role - if any - of excessive gestational weight is poorly documented.

The aim of this study was to determine the prevalence of excessive gestational weight gain, its risk factors, the socio-obstetrical profile of women with excessive gestational weight and the effects of abnormal GWG on pregnancy outcome.

Patients and Methods

Study design

This study was a hospital-based descriptive, cross-sectional study.

Study setting

The study was carried out in Cité des Palmiers District Hospital and Our Lady of Love Catholic Hospital, Douala from 1st December, 2014 to 28th February, 2015. Douala is the economic capital of Cameroon and a cosmopolitan city of 1,338,082 inhabitants [22]. Ethical clearance for the study was obtained from the Faculty of Health Sciences Institutional Review Board. Administrative clearance was given by the Regional Delegate of Health and the Chief Medical Officers of both hospitals.

These hospitals are located in Cité des Palmiers Health District which is one of the thirty health districts in Douala. The hospitals were chosen because they have well equipped maternities; women of all social classes are attended to in these hospitals and about 90 - 120 deliveries are done in each maternity monthly. Each of the hospitals has a gynecologist, pediatrician, six midwives and some auxiliary staff.

Sample size calculation

The sample size was calculated using the formula for comparing two proportions [23].

$$n = \frac{3X[z_{crit}\sqrt{2P(1-P)} + Z_{pwr}\sqrt{\{P_1(1-P_1) + P_2(1-P_2)\}}]^2}{D^2}$$

For a confidence level of 95%, $Z_{crit} = 1.96$, Z_{pwr} = standard normal deviate for the desired statistical power of 80% = 0.84. The pre-

study prevalence of adverse outcome in participants with excessive gestational weight gain (P_1) is 22.6% [9] while that in women with normal weight (P_2) = 7.96% = 0.08 [9]. D is the minimum expected difference ($P_1 - P_2$). A minimum sample size of 303 pregnant women was required. However, three hundred and fifty participants were enrolled in anticipation for loss to follow up.

Study population and sampling

Inclusion criteria: All pregnant women who opted to deliver in Our Lady of Love Hospital Makepe, Douala, and Cité des Palmiers District Hospital Douala, with recorded pre-pregnancy weight or weights measured on or before thirteen weeks of gestation and who gave formal consent (written consent) were enrolled.

Exclusion criteria: The following groups of participants were excluded from the study; participants with multiple gestations, chronic diseases (such as hypertensive disorders, uncontrolled diabetes mellitus, chronic heart failure, thyroid dysfunction, chronic renal disease or a psychiatric disease treated with neuroleptic). Patients without recorded pre-pregnancy weight, those with pregnancy weight measured after 13 weeks of gestation or those who could not recall their prepregnancy weights and were consulted for the first time after the first semester.

Study procedure

Approach to participants: A consecutive convenient sampling method was used to select participants for the study. The study and its aims were clearly explained to the participants. Participants were reassured that questionnaires will be coded to ensure confidentiality. Their heights during the first Antenatal Consultation (ANC) and weights during subsequent visits were measured using standard procedures. The participants had their Antenatal Consultations (ANC) in one of the hospitals near their catchment area. ANC was provided by the gynecologist and the midwives. Appointments were scheduled based on the complications if any were diagnosed during the antenatal period. Any complication detected was managed in the unit by the gynecologist and nurses. All deliveries took place at the study sites. There were no losses to follow up.

Data collection: Data was collected using an interviewer-administered pretested questionnaire. Information was obtained on socio-demographic characteristics, anthropometric data, potential confounders (e.g. pre-pregnancy hypertension, heart failure, chronic kidney disease, etc) factors associated with pre-pregnancy obesity (physical activity, sedentary life style, vegetable and fruits consumption, skipping breakfast, sweetened snacks between meals, number of meals per day, use of oral contraceptives and family history of obesity). Information on maternal outcomes (pre-eclampsia, eclampsia and gestational diabetes, type of labor, type of delivery, perineal tear, episiotomy and postpartum hemorrhage) and neonatal outcomes (still birth, Apgar score, sex of the baby, birth weight, birth injury and early perinatal death) were also retrieved.

Data management: Body mass indices and gestational weight gain can be defined as the difference between the highest weight gained during pregnancy and the pre-pregnancy weight [4]. Based on these, participants were classified in three categories: 'less than recommended GWG', 'normal GWG' and 'excessive GWG' according to the American institute of medicine guide line (Table 1) and subsequently

Table 1: Maternal weight gain of participants based on the American institute of medicine classification.

Pre-pregnancy BMI category	Mean value of weight gain within 2 nd and 3 rd Trimester (Kg / week)	Recommended range of weight gain(kg)
BMI < 18.5 (underweight)	0.5	12.5 -18
BMI 18.5-24.9 (normal weight)	0.4	11.5 -16
BMI 25-29.9 (Overweight)	0.3	7 – 11.5
BMI ≥ 30 (obese)	0.2	5 - 9

Adapted from American Institute of Medicine, 2009 cited in Rasmussen and Yaktine, 2009.

Table 2: Socio-Demographic characteristics of 350 participants.

Parameters	Frequency	Percentage (%)	95% CI	
Age (years)	<25	105	30.0	25.3 – 35.1
	25-34	211	60.3	54.9 -65.4
	>34	34	9.7	6.9 – 13.4
	Single	96	27.4	22.9 - 32.5
Marital Status	Married/cohabiting	253	72.3	67.2 – 76.9
	Divorce/separated	1	0.3	0.01 – 1.8
	Primiparous	115	32.9	28.0 – 38.1
Parity	Multiparous	216	61.7	56.4 – 66.8
	Grandmultiparous	19	5.4	3.4 – 8.5
	Employed	170	48.6	43.2 – 53.9
Occupation	Unemployed	108	30.9	26.1 – 36.0
	Student	72	20.6	16.5 – 25.3
	Non-scholarized	1	0.3	0.01 – 1.8
Education	Primary	33	9.4	6.7 – 13.1
	Secondary	213	60.9	55.5 – 65.9
	Tertiary	103	29.4	24.8 – 34.6

as non-obese and obese. Data entry was double-checked. This was done initially by the principal investigator. Furthermore, 10% of the questionnaires were verified by another investigator for completeness of data entry. Data was cleansed and saved in the hard drive of the computer as back-up. The data was analyzed using Epi Info™ 7.1.4.0 software. In describing the socio-demographic and obstetric characteristics, measures of central tendencies like the mean and median were used. For categorical data, frequencies were computed. Chi-squared, Fisher’s exact tests were used to compare proportions and determine the strength of association between variables. P-values of less than 0.05 were considered statistically significant.

Results

Socio-Demographic characteristics of the study participants

As shown in table 2, the mean age of the participants was 27.5 ± 5.0 years with an age range of 16 to 45 years. Two hundred and eleven (60.3 %) participants were in the age group of 25-34 years. The median age was 27 years. Those legally married/cohabiting or single were 253 (72.3 %) or 96 (27.4 %) respectively. Their parity ranged from one to eight with a median of two. Multiparity was most represented 216 (61.7%) amongst participants. The majority of the women 170 (48.6%) were self-employed. Of the 350 women, 213 (60.9 %) had

Table 3: Anthropometric characteristics of 350 participants.

Characteristic	Frequency	Percentage	95% CI	
BMI (kg/m ²)	Under weight (<18.5)	8	2.3	1.1 – 4.6
	Normal wt. (18.5 < 25)	176	50.3	44.9 – 55.6
	Overweight (25<30)	115	32.9	28.0 – 38.1
	Obesity (≥30)	51	14.6	11.1 – 18.8
Gestational weight gain	Less than recommended	129	36.9	31.8 – 42.2
	Recommended	114	32.6	37.8-27.7
	More than recommended	107	30.6	25.8 – 35.7

Table 4: Socio-Obstetrical characteristics of 107 women with excessive GWG.

Parameters	Frequency	Percentage (%)	95% CI	
Age (years)	<25	28	26.2	18.2 – 35.55
	25-34	67	62.6	52.8 - 71.8
	>34	12	11.2	5.9 – 18.8
Marital Status	Single	35	32.7	24 – 42.5
	Married/cohabiting	71	67.3	56.6 – 75.2
	Divorce/separated	1	0.9	0.02 – 5.1
Parity	Primiparous	34	31.78	23.1 – 41.5
	Multiparous	66	61.7	51.8 – 70.9
	Grandmultiparous	7	6.5	2.7 – 13.0
Occupation	Employed	63	58.9	49.0 – 68.3
	Unemployed	27	25.2	17.3 – 34.6
	Student	17	15.9	9.5 – 24.2
Education	Non-scholarized	1	0.9	0.02-5.1
	Primary	9	8.4	3.9 – 15.4
	Secondary	68	63.6	53.7 – 72.6
	Tertiary	29	27.1	19.0 – 36.6
BMI Category	Non-obese	87	81.3	72.6 – 88.2
	Obese	20	18.7	11.8 – 27.4

attained secondary education. Other demographic characteristics are shown in (Table 2).

Body Mass Index (BMI) distribution in the population

The BMI ranges between 16.8 – 43.4 kg/m² with a mean of 25.24 ± 4.5kg/m². The median BMI was 24.76 kg/m². Of the 350 women, 8 (2.3 %) were underweight, 176 (50.3 %) had normal weight, 115 (32.9 %) were overweight and 51 (14.6 %) were obese (Table 3).

Weight gain patterns in the 350 participants

In this study, weight gain patterns were assessed according to the American Institute of Medicine’s guidelines for weight gain during pregnancy [4]. Out of the 350 women, 129 (36.9%) had less than recommended weight gain, 114 (32.6%) had recommended weight gain and 107 (30.6%) had more than recommended weight gain (Table 3).

Socio-Obstetrical profile of 107 women with excessive gestational weight gain

As shown in Table 4, the ages of women with excessive GWG ranged from 16 – 45 years, with a mean age of 28.06 ± 5.2 years. Of the 107 women, 67 (62.6%) were within the age range of 25-34years. Most of the obese women were either married/cohabiting 71 (66.3%) or single 35 (32.7%). The parities ranged between 1 and 8 deliveries with

Table 5: Gestational weight gain and outcome of pregnancy.

Outcome of Pregnancy	< Rec GWG (N=129)		Rec GWG (N=114) (Ref)		> Rec GWG (N=107)		Total (N=350)		P-Value
	No.	%	No.	%	No.	%	No.	%	
Induced Labor	21	16.3	15	13.16	19	17.76	55	15.7	0.61 ^{χ²}
C/S	22	17.1	19	16.7	19	17.8	60	17.1	0.98 ^{χ²}
Genital tears	27	20.9	34	29.8	27	25.2	88	25.1	0.18 ^{χ²}
Episiotomy	17	13.2	10	8.8	8	7.5	35	10.0	0.36 ^{χ²}
Premature birth	8	6.2	3	2.6	9	8.4	20	5.7	0.17 ^F
GD	1	0.8	2	1.8	0	0	3	0.9	0.36 ^F
PPH	7	5.4	2	1.8	8	7.5	17	4.9	0.13 ^F
Pre/eclampsia	4	3.1	2	1.8	16	15.0	22	6.3	0.0003 ^F

χ²: P-value obtained from the Uncorrected Chi square test.

C/S: Caesarean section

F: P-value obtained from Fisher-Exact test

GD: Gestational Diabetes

Pre/eclampsia: Preeclampsia or eclampsia

PPH: Post-partum hemorrhage

No. : Number of Women with the respective parameter

%: Percentage of women in the various groups

a median of two. Most of these women 66 (61.7 %) were multiparous. Sixty-three (58.9%) were employed 27 (25.3%) unemployed and 17 (15.9%) were students. Sixty eight participants (63.6%) had secondary level of education.

Of the 107 women with excessive GWG, 87 (81.3%) were not obese while 20 (18.7%) were obese.

Gestational weight gain and outcome of pregnancy: Excessive gestational weight gain was not significantly associated with an increase rate of induction of labor, preterm labor, gestational diabetes, caesarean delivery, genital tears, episiotomy and postpartum hemorrhage when compared to patients who had normal GWG. P-Values were greater than 0.05 (Table 5).

There was a significant difference in the prevalence of pre-eclampsia or eclampsia in the different GWG groups. Those who gained weight more than the recommended value, 16 (14.95%) had the highest prevalence of pre-eclampsia/eclampsia compared to 2 (1.7%) who had recommended weight gain during pregnancy. (Fisher’s-Exact: P = 0.0003) (Table 5).

Fetal outcome of pregnancy with respect to gestational weight gain:

Out of the four variables used in assessing fetal outcomes (still birth, macrosomia, small for gestational age and APGAR in the first minute less than 7), only fetal macrosomia was significantly associated with excess weight gain in pregnancy. Of the participants who gained weight more than RGW, 10 (9.4%) had a higher prevalence of macrosomic babies than those (6 [5.3%]) with recommended GWG and 5 (3.9%), with less than recommended GWG (P= 0.04) (Table 6).

Discussion

Prevalence of excessive gestational weight gain

The prevalence of excessive weight gain in our study was 30.6% which is lower than the 33.1% obtained among Vietnamese women [24] in 2011 and the 48.7% obtained among Canadian women in 2012 [25]. This value may be relatively lower in our setting because many people are becoming aware of the adverse outcome of excessive

Table 6: Fetal outcome with respect to gestational weight gain.

Outcome of Pregnancy	<Rec GWG (N=129)		Rec GWG (N=114)		> Rec GWG (N=107)		Total (N=350)		P-Value
	No.	%	No.	%	No.	%	No.	%	
Still birth	2	1.9	0	0	1	0.9	3	0.9	0.48 ^F
Macrosomia	5	3.9	6	5.3	10	9.4	21	6.0	0.04 ^{χ²}
Small for GA	16	12.4	11	9.7	8	7.5	35	10.0	0.66 ^{χ²}
Apgar in 1 st min <7	11	8.5	6	5.3	3	2.8	20	5.7	0.16 ^{χ²}

χ²: P-value obtained from the Uncorrected Chi square test.

%: Percentage of women in the various groups

F: P-value obtained from Fisher-Exact test

No.: Number of women with the respective parameter

GA: Gestational Age

weight gain on pregnancy outcome. The nutritional habits of the participants might also be contributory.

Socio-demographic characteristics

The age of the participants ranged between 16 and 45 years with a mean age of 27.5±5 years. This was similar to the range of 14 – 46 years (mean age 27.45 years) obtained by Geidman et al., 2009 in Nigeria [26] but was however higher than 26.4 ± 5.8 years obtained by Njim, 2014 in Buea [27] and lower than 29.8 ± 5.8years obtained by Scott-Pillai et al., 2013 in the UK [28] and the value of 31.1years obtained by Kamadjeu et al, in Cameroon [5]. The majority of the women were within the age group of 25–34 years (60.29%). However Yongsi et al, 2012 [29] in Cameroon and Gabon had a different trend with the less than 25-year age group being most represented (40.13%). The high population prevalence within the age group of 25–34 years is likely due to the fact that this study was conducted on women who had just delivered and this is the age range for high reproductive activity. Furthermore, a majority of the women aged 25-34 years (75.83%) were either married or cohabiting, thus making it more likely for them to become pregnant, thereby increasing their chances of being included in the study.

In this study population, 253 (72.3%) women were either married or cohabiting while 96 (27.4%) were single. Similar findings were obtained by other researchers [17,24,30], where married women or those cohabiting constituted a greater proportion of the participants. This high proportion of the married women was probably due to the fact that women in the post-delivery period were enrolled. This ties with the social context where procreation is more acceptable after marriage or when partners cohabit ('union libre').

Most women (61.7%) were multiparous. The percentages of primiparous and grand multiparous were similar to those of Smith et al., 2007 [30], Norh et al., 2008 [31] and Njim, 2014 [27]. However, they differed from the 50.1% primiparity and 49.9% multiparity of Ota et al., 2011 [24]. Most women less than 25years (56.19%) were primiparous while those between 25 – 34years (71.09%) were multiparous. This correlates with the fact that the majority of the participants were within the age group of 25-34 years which is the peak reproductive age group in the community, the primiparous patients usually belonging to the younger age group [9].

Participants were employed (48.6%), unemployed (30.9%) or were students (20.6%), figures similar to those of Ota et al., 2011 [24] where 61.6% were employed and 38.4% unemployed and to Sidik

and Rampal, 2009 [17], where 40.1% were employed. Though the unemployment rate appears high (30.9%), it reflects the Cameroon 30% unemployment rate for females in a 2001 survey [32].

Out of the 350 women, 129 (36.9%) had less than recommended weight gain, 114 (32.8%) had recommended weight gain and 107 (30.6%) had more than recommended weight gain. The slight increase in those with less than recommended weight gain as opposed to the other groups is probably due to the fact that many women are becoming aware of the fact that excessive weight gain during pregnancy has adverse effects on the pregnancy outcome. However, they do not know exactly what the optimal weight gain for their BMI category is; they might therefore engage in practicing weight losing regimens or exercises in an attempt not to gain weight, but end up being underweight.

Gestational weight gain and maternal outcome of pregnancy

In our study, only pre-eclampsia/eclampsia was significantly found to be associated with more than recommended gestational weight. This was similar to findings by Mbu et al., 2013 and Tabot et al., 2013 [7,8]. Induced labor, caesarean section, genital tear, episiotomy, premature birth, gestational diabetes and postpartum hemorrhage were not associated with gestational weight gain in this study.

Gestational weight gain and fetal outcome

Macrosomia was associated with more than recommended GWG. Small for gestational age was higher in those with less than recommended GWG though this difference was not statistically significant. These findings are consistent with findings in Cameroon, Bavaria and Vietnam [7,8,24] which are all low income countries.

Study Limitations

The study was subjected to recall bias since information on the pre-pregnancy weight was obtained from the participants. Moreover, these weights were measured by different persons using different instruments which were not standardized. Hence the study was subject to observer bias and instrument bias. The heights measured at the time of interview might not have been pre-pregnancy heights especially for teenage mothers. Furthermore, the study was restricted to two hospitals in Douala which is not representative of health facilities in Douala.

Conclusion

The prevalence of excessive gestational weight gain of 30.7% in these hospitals was high. More than recommended gestational weight gain was associated with increased incidence of hypertensive disorders in pregnancy and fetal macrosomia.

Acknowledgement

We are grateful to all the women who took part in the study and the personnel of the two hospitals for their assistance. The administrative authorities very supportive and provided us partial financial assistance. The crucial roles played by the head nurses of the maternities of both hospitals in collecting data facilitated our task immensely. The supportive role played by some final year medical students working in the hospitals where the study was carried out, was recommendable.

Competing Interests

Dr Gregory Edie Halle-Ekane is a member of the Editorial Board of the Journal but the manuscript underwent the same review process like other manuscripts. The other authors do not have any competing interests.

Author's Contributions

This work was carried out in collaboration with all authors. Authors GEHE and JBN did the study design and wrote the protocol and manuscript. Authors JA, JNP, CTN, and PNN did the literature search, cross-checked the statistical analysis and made important inputs in the drafting of the manuscript. DSN cross-checked the data entry while JBN analysed the data. GEHE is the corresponding author. All authors read and approved the final manuscript.

References

1. WHO. Obesity and Overweight. 2015.
2. Shahi M, Rai L, Adhikari RD, Sharma M. Prevalence and Factors Associated with Obesity among Adult Women of Nepal. *GJMEDPH*. 2013; 2: 1-9.
3. Jorgensen AM. The Impact of Maternal Obesity on Antepartum Risk, Intrapartum Risk and Adverse Neonatal Health Outcomes. *NICU Curr*. 2010; 1: 1-12.
4. Rasmussen MK, Yaktine A. Weight Gain during Pregnancy: Reexamining the Guidelines. 1st edn. Washington: National Academic Press. 2009.
5. Kamadjeu RM, Edwards R, Atanga JS, Kiawi EC, Unwin N, Mbanya J-C. Anthropometry Measures and Prevalence of Obesity in the Urban Adult Population of Cameroon: an update from the Cameroon Burden of Diabetes Baseline Survey. *BMC Public Health*. 2006; 6: 228.
6. Bray GA. Pathophysiology of Obesity. *Am J Clin Nutr*. 1992; 55: 488S-494S.
7. Mbella G. Hypertension Kills More Women. *Cameroon Tribune*. 2012.
8. Tabot MK. The Effects of Gestational Weight Gain on the Outcome of Delivery at the Central Maternity of the Yaounde Central Hospital. *The Journal of Medicine and Health Sciences*. 2013; 3: 6-8.
9. Mbu RE, Fouedjio HJ, Tabot M, Fouelifack FY, Tumasang FN, Tonye RN et al. Effects of gestational weight gain on the outcome of labor at the Yaounde central hospital maternity, Cameroon. *Open J Obstet Gynecol*. 2013; 3: 648-652.
10. Nana P, Wandji J, Fomulu J, Mbu R, Tonye R, Ako S et al. Materno-Foetal Outcome of Labour in Obese Women in Yaounde, Cameroon. *Clinics in Mother and Child Health*. 2009; 6: 989-993.
11. Hickey CA, Cliver SP, McNeal SF, Hoffman HJ, Goldenberg RL. Prenatal Weight Gain Patterns and Birth Weight among Non obese Black and White Women. *Obstet Gynecol*. 1996; 88: 490-496.
12. Siega-Riz AM, Viswanathan M, Moos M-K, Deierlein A, Mumford S, Knaack J et al. A Systematic Review of Outcomes of Maternal Weight Gain According to the Institute of Medicine Recommendations: Birth Weight, Fetal Growth, and Postpartum Weight Retention. *Am J Obstet Gynecol*. 2009; 201: 339.e1-14.
13. Lohr KN. Nutrition during Pregnancy: Part I: Weight Gain, Part II: Nutrient Supplements. Washington, D.C. National Academy Press. 1990.
14. Scholl TO, Hediger ML, Schall JI, Ances IG, Smith WK. Gestational Weight Gain, Pregnancy Outcome, and Postpartum Weight Retention. *Obstet Gynecol*. 1995; 86: 423-427.
15. Blomberg MI, Källén B. Maternal Obesity and Morbid Obesity: The Risk for Birth Defects in the Offspring. *Birth Defects Res A Clin Mol Teratol*. 2010; 88: 35-40.

16. Oken E. Maternal and Child Obesity: the Causal Link. *Obstet Gynecol Clin North Am.* 2009; 36: 361-377.
17. Sidik SM, Rampal L. The Prevalence and Factors Associated with Obesity Among Adult Women in Selangor, Malaysia. *Asia Pac Fam Med.* 2009; 8: 2.
18. Wen W, Gao Y-T, Shu X-O, Yang G, Li H-L, Jin F et al. Sociodemographic, Behavioral, and Reproductive Factors Associated with Weight Gain in Chinese Women. *Int J Obes Relat Metab Disord.* 2003; 27: 933-940.
19. Weisman CS, Hillemeier MM, Downs DS, Chuang CH, Dyer A-M. Preconception Predictors of Weight Gain during Pregnancy: Prospective Findings from the Central Pennsylvania Women's Health Study. *Women's Health Issues.* 2010; 20: 126-132.
20. Nohr EA, Vaeth M, Baker JL, Sørensen TIA, Olsen J, Rasmussen KM. Pregnancy Outcomes Related to Gestational Weight Gain in Women Defined by their Body Mass Index, Parity, Height, and Smoking Status. *Am J Clin Nutr.* 2009; 90: 1288-1294.
21. Cresswell JA, Campbell OMR, De Silva MJ, Filippi V. Effect of Maternal Obesity on Neonatal Death in Sub-Saharan Africa: Multivariable Analysis of 27 National Datasets. *Lancet.* 2012; 380: 1325-1330.
22. Cameroon - City Population.
23. Eng J. Sample Size Estimation: How Many Individuals Should Be Studied?. *Radiology.* 2003; 227: 309-313.
24. Ota E, Haruna M, Suzuki M, Anh DD, Tho LH, Tam NTT, Thiem VD, et al. Maternal Body Mass Index and Gestational Weight Gain and their Association with Perinatal Outcomes in Viet Nam. *Bull World Health Organ.* 2011; 89: 127-136.
25. Government of Canada PHA of C. Obesity in Canada - Healthy Living. Ottawa. Public Health Agency of Canada. 2011.
26. Geidam AD, Audu BM, Kawuwa BM, Obed JY. Rising Trend and Indications of Caesarean Section at the University of Maiduguri Teaching Hospital, Nigeria. *Ann Afr Med.* 2009; 8: 127-132.
27. Njim TN. Prevalence, Determinants And Complications Of Abnormal Birth Weights in the Buea Regional Hospital. MD thesis. University of Buea, Buea Cameroon. 2014.
28. Scott-Pillai R, Spence D, Cardwell CR, Hunter A, Holmes VA. The Impact of Body Mass Index on Maternal and Neonatal Outcomes: A Retrospective Study in a UK Obstetric Population, 2004-2011. *BJOG.* 2013; 120: 932-939.
29. Yongsi HBN, Ngwa OA. Trends and Risks Factors Associated to Women Obesity in Cameroon and Gabon. *Am J Health Res.* 2014; 2: 420-428.
30. Smith GCS, Shah I, Pell JP, Crossley JA, Dobbie R. Maternal Obesity in Early Pregnancy and Risk of Spontaneous and Elective Preterm Deliveries: A Retrospective Cohort Study. *Am J Public Health.* 2007; 97: 157-162.
31. Nohr EA, Vaeth M, Baker JL, Sorensen TI, Olsen J, Rasmussen KM. Combined Associations of Prepregnancy Body Mass Index and Gestational Weight Gain with the Outcome of Pregnancy. *Am J Clin Nutr.* 2008; 87: 1750-1759.
32. The World Fact book. Cameroon Statistics. 2015.