__Original Research Article__

Maternal Anthropometry and Dietary Diversity associated with Birth Weight in Maternities of Abidjan (Côte D'Ivoire)

ABSTRACT:

Aims: Birth weight is a powerful predictor of infant growth and survival, and depends on the fetal growth environment, which is influenced by maternal nutritional status. However, the association between maternal anthropometric and nutritional factors and birth weight is not well characterized in Côte d'Ivoire. The objective of this study was to determine the maternal anthropometric and nutritional characteristics associated with birth weight.
Study design: This was a retrospective study
Place and Duration of Study: This study was done in the maternity of three municipalities of Abidjan, Côte d'Ivoire, from 1er October to 30 November 2018.
Methodology: It consisted in collecting birth data from 146 newborns born from a monofetal pregnancy, whose mothers aged 20 to 42 had participated in a previous survey. Also, the relationship between birth weight, maternal anthropometry and maternal nutrition factors has been studied. Univariate, bivariate and multivariate data analysis was done using SPSS version 25 software.
Results: The results indicate mean birth weight of 3118.48 ± 515.39g and 7.6% and 5.5% respectively of low and excess birth weight. In a multivariate linear regression, the mean birth weight of newborns of women with medium and high dietary diversity score was higher than those newborn of women with low dietary diversity score (AOR = 0.386, 95% confidence interval (CI) : 0.072 - 0.699 ; p = 0.017 and AOR= 0.233, 95% CI : 0.016 - ,450 ; p = 0.036). Similarly, women with gestational weight gain greater than 7 kg and high stature (> 1.55 cm) gave birth to heavier children (AOR = 0.551, 95% CI: 0.346 - 0.756, p = 0.000 and AOR = 0.633, 95% CI: 0.207 - 1.059 ; p = 0.004, respectively)
Conclusion: Although it revealed the presence of low and excess birth weight, this study has shown that maternal anthropometry and dietary diversity score were associated with birth weight of the baby.

Keywords:Pregnancy, Maternal anthropometry, Dietary diversity, Birth weight, Abidjan

1. INTRODUCTION

Adequate maternal nutrition during the period from conception to birth was considered as an important determinant for the harmonious development of pregnancy and fetal growth and child health [1-3]. Infant birth weight is a powerful predictor of infant growth and survival, and depends on the fetal growth environment, which is influenced by maternal nutritional status [4]. Prenatal factors, such as maternal nutrition, determine fetal growth during the gestation period [2], and hence anthropometric measurements of infants at birth.Many maternal and fetal complications due to inadequate nutrition during pregnancy have been noted, including intrauterine growth retardation, abortions, premature delivery, fetal malformations and low birth weight [5].

Current research pointed out that the first 1000 days of life (up to two years of life) are crucial for the prevention of illness in adulthood [6]. According to Schmidt et al. [7] a delay in child growth is due to inadequate maternal dietary intake rather than exposure to postnatal environmental factors.Hence the importance of dietary diversification and micronutrient intakes as recommended by international dietary guidelines [8, 9].
The use of the dietary diversity score has been recommended as a valid indirect indicator for assessing dietary intakes in population studies, particularly among women of childbearing age [10, 11]. Dietary diversity during pregnancy has been explored by several authors [12-15] to assess maternal nutritional status and pregnancy outcomes but with divergent results. Indeed, as modifiable risk factors, the study of eating habits often associated with increased risks of adverse outcomes of pregnancy [16, 17], can be integrated into pregnant women health care.
Fetal growth and birth weight are also influenced by maternal weight, height, body mass index (BMI) and total gestational weight gain [18-22]. However, BMI during pregnancy and gestational weight gain have identified as the most important determinants of birth weight [21, 22].Better growth and favorable pregnancy outcomes then depend on appropriate maternal height and weight.
In Côte d'Ivoire, several studies on dietary behaviour and anthropometry have focused on schoolchildren, non-pregnant women of childbearing age and students [23-25], except on newborn birth weight. According to the literature, pregnancies in this country are associated with adverse outcomes such as low birth weight (LBW) with a prevalence of 13% in Abidjan and 14% at the national level [26]. However, the association between birth weight, maternal anthropometric and nutritional factors is not well characterized in Côte d'Ivoire, and in particular in Abidjan. Therefore, this study was designed to study the effect of maternal anthropometric and nutritional characteristics on the birth weight of the newborn.

2. MATERIAL AND METHODS

2.1. Conceptual framework of Study

This study was designed to examine the relationship between maternal characteristics in pregnant women in the 3rd trimester of pregnancy who participated in a previous nutritional survey and birth weight of their newborns. The conceptual framework of the study is shown in Figure 1.

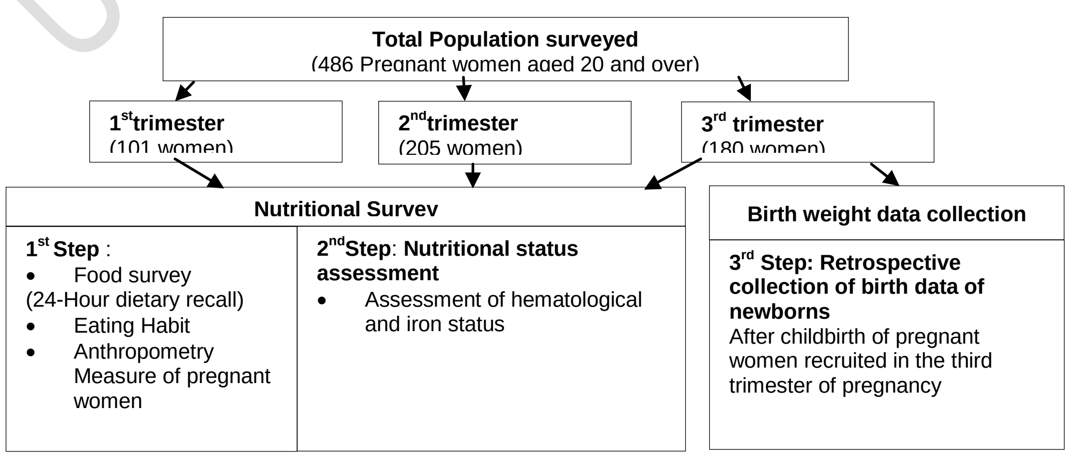

Fig1. Conceptual framework for retrospective study of newborn birth data of pregnant women collected in the 3rd trimester of pregnancy.

2.2. Study area and Population

This study was carried out in the maternity services of the municipalities of Yopougon, Abobo and Cocody in city of Abidjan. These are the maternity hospitals of the General Hospital of Yopougon Attié, the Urban Health Centers with Community Base (CSUCOM in french) of Abobo-Té and Anono Riviera-2. The study population consisted of 146 mother-child couples whose birth and delivery data were collected.

2.3. Study design and Period

This was a retrospective study that took place from October 1 to November 30, 2018. It involved the collection of birth data for newborns and the pregnancy delivery of women by consulting birth records.

2.4. Selection of samples and inclusion criteria

All newborn birth data available in the birth registers of the maternity units selected in the previous study were included. These were newborns, born alive by the vaginal or cesarean section, from a monofetal pregnancy of pregnant women in the previous nutritional survey. Those whose baby data were not available were contacted by telephone. A total of 146 newborns made up the study population. Therefore, a sampling method was not used for the size and selection of the study population.

2.5. Data collection and Study variables

The collection of newborn birth data and maternal characteristics at birth was carried out retrospectively. However, the nutrition survey that preceded this study collected socio-demographic, economic, obstetrical and prenatal data. Similarly, dietary habits and a 24-hour recall were conducted during this investigation. In addition, blood tests were performed on blood collected from these women in the third trimester of pregnancy.

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It should be noted that the pregnant women recruited in the previous study were apparently healthy, with no high-risk pregnancies, no diagnosis of gestational diabetes, hemoglobinopathies and clinical signs of malaria.

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2.1.1 Socio-demographic and economic characteristics

The economic situation of the household as measured by the well-being index is based on the non-monetary approach to household poverty developed by Garenne and Hohmann[27]. Principal Component Analysis (PCA) was used to select the variables to be included in the index calculation. The well-being quintile obtained, was later classified as a well-being tercile (low, medium and easy). The variables selected for the socio-economic level in this study come from the work of [28] on the mapping of non-financial poverty in the district of Abidjan, from 2014 Côte d'Ivoire's General Population and Habitat Census (RGPH *in french*)

2.1.2. Dietary diversity assessment

Dietary diversity measure refereds to whether or not 9 food groups were consumed in the 24 hours preceding the survey. Using information collected as part of the 24-hour dietary recall, Women Dietary Diversity Scores (WDDS) were calculated using FAO guidelines [29]. One point was assigned to each food group consumed during the reference period, and the sum of all points was calculated for the dietary diversity score for each woman. These nine food groups are: starches, dark green leafy vegetables, meat and fish, other vegetables and fruits, vegetables and fruits rich in vitamin A, liver, milk and dairy products, egg, pulses, nuts and seeds. The tercile classification of dietary diversity was derived from these food groups. A scale was established for this distribution: low (1-3 food groups), medium (4-5 food group) and high (4-9 food group) [29].

2.1.3.Blood samples collection and Analysys

In each of the enrolled women, a blood sample from a dry tube (without anticoagulant) and an EDTA tube of 5 ml each, was taken on a fast basis at the bend of the elbow in the morning. Hematological parameters are measured immediately on samples collected from EDTA tubes by an automatic Sysmex-XN 1000 hematological analyzer. The samples contained in the dry tubes are centrifuged at 3000 revolutions/min for 5 min and the serum is aliquoted and stored at - 20°C. The determination of the of biochemical parameters of iron status was carried out on the Cobas C 311 automaton (*Roche*^{R}). Biochemical markers of the martial balance are serum ferritin, serum iron and serum transferrin. The total iron binding capacity (TIBC) and the iron transferrin saturation coefficient (TSC) were calculated. Anemia was defined according to WHO criteria as a hemoglobin level below 11 g/dl in pregnant women. Martial deficiency was established for ferritin values below 20 µg/l with or without inflammatory status. Similarly, in the presence of an inflammatory state, iron deficiency is shown for ferritin values between 20 and 100 µg/l. While ferritin values greater than 100 µg/l indicate normal iron status regardless of inflammatory status. All biological analyses were carried out at the Unit of Clinical Biochemistry and Hemobiology ofPasteur Institute of Côte d'Ivoire (IPCI).

2.1.4. Gestational weight gain and Anthropometry of newborn

The weight, size of the mother and MUAC were recorded from the examination of the pregnancy follow-up diary and Antenatal care (ANC) visit. Examination of the mother's health record and ultrasound also determined the gestational age of women at recruitment and delivery. Gestational weight gain is calculated by subtracting the weight before pregnancy or, failing that, at the beginning of pregnancy from the weight at the end of pregnancy (usually measured just before giving birth). The total number of ANC, term and delivery mode were also collected. Weight, height, and cranial perimeter were identified by consulting birth records in maternity facilities.

2.1.6. Statistical Analysis

Analysis of the collected data was both qualitative and quantitative using IBM SPSS statistic 25 software (SPSS Inc., Chicago, USA). Quantitative variables were expressed as mean and standard deviation and qualitative variables as a percentage. The different frequencies were compared using the Chi-2 test or Fisher test. Socio-demographic, economic, obstetrical and prenatal characteristics as well as dietary and biological factors were the independent variables. Birth weight (BW) of the newborn as a pregnancy outcome, was continuous dependent variable. The association between quantitative dependent variable (BW) and each of explanatory variables (continuous or categorical), was explored in a univariate linear regression model. The independent variables at $p < 0.20$ were then entered into the multivariate linear regression model using stepwise method. Effect of certain maternal characteristics on birth weight of the newborn after adjusting the confounding factors to the threshold of significant $p < 0.05$ was retained. The Kolmogorov-Smirnov test was used to assess the normality of the variables.

3. RESULTS AND DISCUSSION

3.1. Characteristics of pregnant women in the 3rd trimester of pregnancy

Maternal characteristics included socio-demographic, economic, obstetrical factors and prenatal monitoring, as well as dietary habits of women in the third trimester of pregnancy. The age of study participants was ranged from 20 to 42 years with mean age of 28.44 ± 5.88 years and 39.7% of participants in the 25 to 30 year age group. 42.1% of pregnant women were from the Akan ethnic group, 40.4% from secondary school and 44.7% from income-generating activities compared to 36% from housewives. More than two-thirds of women lived in couples (72.4%) with only 25 women, or 17.2%, who were legally married. The mean household size was 4.27 ± 2.09 persons per household.
About 38% of pregnant women belong to households with a low well-being index. Among the surveys, 56 women, or 38.4% were first born. More than three-quarters of women, 77.8% had inter-pregnancies interval older than 24 months. About 60% of pregnant women had completed their first ANC before the end of the first trimester of pregnancy. Up to the time of delivery, 75.3% of women received at least 4 ANC according to the recommendations of the Health Authorities of Cote d'Ivoire (Table 1.).
More than two-thirds of pregnant women, or 80.8%, took at least all three meals per day with a mean of 3.27 ± 0.9 meals per day. Only 47.6% took the snack as an additional meal per

day. Clay consumption or Pica was found in 21.2% of pregnant women, while 31.5% of alcoholic beverages were consumed. No woman used tobacco during pregnancy.

Table 1. Description of the characteristics of women in the 3rd trimester of pregnancy in the maternity of three municipalities of Abidjan

Variables	Frequency	Percent/Mean ± sd
Age group		28.44 ± 5.88 years
20 - 25 years	42	28.8
25 - 30 years	58	39.7
> 30 years	46	31.5
Ethnic groups		
Akan	61	42.1
krou	29	20
Mandé	14	9.6
Gour	14	9.7
Other nationalities	27	18.6
Marital status		
Concubine	52	35.9
Single person	39	26.9
Traditional marriage	28	19.3
Legal marriage	25	17.2
Education level of mother		
None	24	16.4
Primary	19	13.0
Secondary	59	40,4
Superior	44	30.1
Occupation of women		
Trader and hairdresser	59	44.7
Employee (public or private)	26	19.7
Housewife	47	35.6
Household size		4.47 ± 2.37 persons
1 - 4 persons	70	47.9
5 - 6 persons	52	35.6
7 persons and over	24	16.4

Table 2: Description of the characteristics of women in the 3rd trimester of pregnancy in the maternity of three municipalities of Abidjan*(continued)*

Variables	Frequency	Percent/Mean ± sd
Wealth-being index		
Low	55	37.7
Medium	37	26.0
High	53	36.3
Obstetrical history and prenatal care		

Inter pregnancy interval		55.13 ± 37.17 months
< 24 months	20	22.2
≥ 24 months	70	77.8
Parity		2.24 ± 1.05
Primipara	56	38.4
Parity 2	46	31.5
Parity 3	21	14.4
At least 4	23	15.8
Iron/folate supplementation		
Yes	114	78.1
No	32	21.9
Antimalarial prophylaxis (IPTp)		
Yes	43	29.5
No	103	70.5
Dietary habits		
Frequency of meals		3.27 ± 0.9 meal per day
< 3	28	19.2
= 3	53	36.3
> 3	65	44.5
Consumption of clay sand (Pica)		
Yes	31	21.2
No	115	78.8
Usual consumption of alcohol in current pregnancy		
Yes	46	31.5
No	100	68.5

3.2. Food consumption of women in the 3rd trimester of pregnancy

3.2.1. Distribution of pregnant women by dietary diversity score

Based on 9 food groups, the mean dietary diversity score was 4.20 ± 1.04. The majority of women (69.8%) consumed at least four food groups in the last 24 hours prior to the study. The distribution of the dietary diversity score among pregnant women in the third trimester of pregnancy is showed in Figure 2. Women in the average dietary diversity score were the most represented with a proportion of 58.3% against 30.8% and 11% respectively for the low and high dietary diversity score.

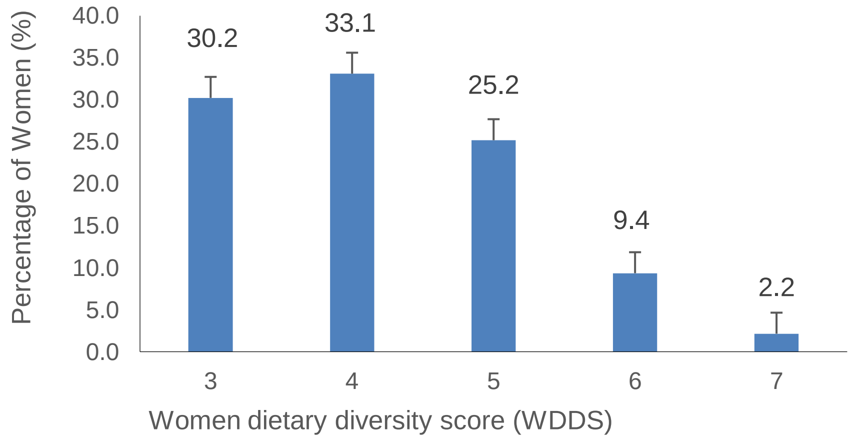

Fig. 2. Distribution of women by dietary diversity score

3.2.2. Dietary profile of women based on 9 food groups

The food consumption profile allowed us to know what pregnant women consumed in each food diversity category. About 30.2% of women were in the category of inadequate diversity compared to 69.8% for the category of adequate diversity (Table 2). The diets of women in the inadequate and adequate diversity category consisted of starches, meat and fish, and other fruits and vegetables, but those in the appropriate diversity category consumed in addition, milk, eggs, fruits rich in vitamins A and dark leafy greens (Table 2).

Table 2: Comparison of food consumption profiles* by dietary diversity category to pregnant women in the 3rd trimester of pregnancy

Dietary diversity category	
Inadequate (< 4 Food groups) *N (%)*	**Adequate (≥ 4 Food groups)** N (%)
44 (30.2%)	102 (69.8%)
Starches Other fruit and vegetables Meat and fish	Starches Other fruit and vegetables Meat and fish Dark green leaf vegetables Fruits and vegetables rich in vitamin A Eggs Milk and dairy products

** For a food group to be included in the dietary profile of a category of women, more than 50% of these women must have consumed that food group*

3.3.Anthropometry, hematological and iron status of pregnant women in the 3rd trimester of pregnancy

The mean value of hemoglobin in the third trimester of pregnancy was 11.02 ± 1.26 g/dl. Anemia in pregnancy, as defined by WHO, was found in 47.3% of pregnant women. This anemia was mild and moderate in 58.2% and 41.8% of women, respectively, and there were no cases of severe anemia. More than half (58.2%) of pregnant women had a martial deficiency in the third trimester of pregnancy. Gestational weight gain was higher (> 7 kg) in 67.4% of women with an average of 7.06 ± 1.51kg, while height was greater than 1.55m in 91.8% of women. Similarly, the majority of pregnant women (84.9%) had a MUAC greater than or equal to 21cm (Table 3).

Table 3. Nutritional status in the third trimester of pregnancy and maternal anthropometry

Variables	Category	Frequency	Percent/Mean ± Sd
			11.02 ± 1.26 g/dl
Hemoglobin (Hb)	No anemia (Hb ≥ 11	77	52.7
	Anemia (Hb < 11 g/dL)	69	47.3
Severity of anemia	Mild (9 – 10.9 g/dL)	85	58.2
	Moderate (7 – 8.9 g/dL)	61	41.8
Iron deficiency	No	38	41.8
	Yes	53	58.2
			1.63 ± 0.06 m
Height	≤ 1.55 m	12	8.2
	> 1.55 m	134	91.8
			26.97 ± 3.56 cm
Maternal MUAC in pregnancy	Undernourished (< 21 cm)	22	15.1
	Normal (≥ 21 cm)	124	84.9
			7.06 ± 1.51 kg
Gestationnal weight gain (GWG)	GWG ≤ 7 kg	48	32.9
	GWG > 7 kg	98	67.1

3.4. Anthropometric characteristics of newborns and term of birth

Table 4 shows 84 newborns (57.9%) were boys, 11 (7.6%) weighed 2500g, 127 (86.9%) weighed 2500 to 3999g and 8 (5.5%) weighed 4000 g. The mean weight was 3118.48g± 515.39g. The gender-based distribution of newborns shows that boys weighed an average of 194 g more than girls (*p = 0.025*). Among these newborns, 142 (97.3%) were born at term of pregnancy (≥ 37 weeks of pregnancy) compared to 4 (2.7%) premature (< 37 weeks of pregnancy).

Table 4. Anthropometrics characteristics of newborn

Variables	Total	Girls	Boys
	N (%)	**N (%)**	**N (%)**
		84 (57.9%)	61(42.1%)
Mean Birth weight	3118.48 ± 515.39 g	3006.23 ± 565.66 g	3200 ± 462.12 g
p		0.021	
Birth weight			
LBW (< 2500g)	11 (7.6%)	9 (81.8%)	2 (18.2%)
NBW (2500 – 3999g)	129 (86.9%)	49 (38.9%)	77 (61.1%)
Excessive Birth ≥ 4000g	8 (5.5%)	3 (37.5%)	5 (62.5%)
p		0.025	
Delivery			
Preterm (< 37 SA)	4 (2.7%)	3 (66.7%)	1 (33.3%)
Term (≥ 37 SA)	142 (97.3%)	59 (41.5%)	83 (58.5%)
p		0.383	

3.5. Multivariate linear regression analysis of maternal characteristics associated with birth weight

Table 5 shows that gestational weight gain, maternal height, and dietarydiversity score were associated with birth weight after adjusting for level of study, well-being index and alcohol consumption in multivariate linear regression. These results show that women with gestational weight gain over 6 kg and tall (> 1.55 m) gave birth to heavier children compared to children of other women with AOR (95% CI) of 0.551, respectively [95% CI: 0.346 - 0.756] and 0.633 [95% CI: 0.207- 1.059]. On the other hand, there was no significant difference in the mean birth weight for women with higher or no level of education. The same is true for the average tercile of well-being and alcohol consumption which were not also significant determinants of birth weight. It is also clear from this table that women with medium dietary diversity score (4 - 5 food groups) and high dietary diversity score (5 - 9 food groups) gave birth to newborn with anmean birth weight greater than those of women with a low dietary diversity score (Table 5).

Table 5. Multivariatelinear regression analysis of maternal characteristics associatedwith mean of birth weight in three maternities in the city of Abidjan

	B	T	p	Borne inf	Borne sup	Tolerance	VIF
(Constant)	1.924	9.066	0.000	1.500	2.349		
Gestational weight gain							
≤ 7 kg	Ref						
> 7 kg	0.551	5.365	0.000	0.346	.756	.719	1.390
Mother's height							
≤ 1.55 m	Ref						
> 1.55 m	.633	2.968	0.004	.207	1.059	.948	1.055
Education level							
None	Ref						
Primary	-						
Secondary	-						
Higher	0.174	1.886	.064	-.010	.359	.944	1.059
Well-being index							
Low	Ref						
Medium	0.124	1.301	.198	-.067	.316	.961	1.040
High	-						
Alcohol consumption							
Yes	-0.137	-1.545	.127	-.315	.040	.988	1.012
Never	Ref						
Dietary Diversity Score							
Low	Ref						
Medium	0.386	2.462	0.017	.072	0.699	0.679	1.472
High	0.233	2.146	0.036	.016	0.450	0.588	1.699

3.6. DISCUSSION

The objective of this study was to determine the maternal anthropometric and nutritional characteristics associated with birth weight of newborns in maternities of three municipalities of Abidjan. The present study recorded birth and delivery data for 146 mother-child couples from the birth register of maternity homes.
The results showed the existence of the cycle of maternal-infant malnutrition reflected by LBW and excess birth weight in the same type of population. These results indicate 7.6% and 5.5% respectively of LBW and excess birth weight. Similar results have been reported in other countries in Africa within the same population type [13,15,30].
For LBW, the results of this study are similar to those of Onubogu et *al.*, [30] in Nigeria, but much lower than 13% and 14% LBW, respectively mentioned in the city of Abidjan and at national level [26]. In Africa, on the other hand, LBW prevalence ranges from 14 to 28%, almost two to three times higher than ours results [13,31,32].The reason why the prevalence of LBW is low in this study might be due on the one hand to the age of mothers. In fact, the authors' studies treated all women of childbearing age between 15 and 49 years, unlike ours, which only included women aged 20 and over. However, a maternal age of less than 20 years has been proved in the etiology of LBW [33-36]. These authors showed that the

risk of giving birth to a LBW child is higher among women under the age of 20 years compared to other adult women. On the other hand, LBW may be due to other pregnancy-related factors. These include poor nutrition, spacing of births, lifestyles (smoking and alcohol use), inadequate prenatal care, overweight, obesity and poverty [33,35,36]. Moreover, according to Gonzalez-Cossio et *al*.,[37] maternal malnutrition and reduced inter-pregnancy intervals, lead to a decrease in physical resources during a new pregnancy, perpetuating the cycle of mother-child malnutrition. This is not the case for more than three quarters of the women in this study where 77.8% and 84.9% respectively observed an interval between pregnancy of at least two years and presented a better nutritional status (PB > 21cm) despite the diagnosis of anemia and martial deficiency at the end of pregnancy.

The prevalence of excess birth weight in this study is 5.5% superimposed on Ezeugwu et *al*., [38]. Excess birth weight in this study could be explained by maternal anthropometry before and during pregnancy as well as gestational weight gain. In addition, several studies have shown that excess birth weight is primarily associated with excess maternal weight before pregnancy, excess gestational weight gain, gestational diabetes and multiparity [13,39,40]. This could be consistent with the characteristics of women in this study with the exception of gestational diabetes. On the other hand, prevalence's of excess birth weight ranging from 7 to 14.8% higher than ours, were found in other countries in Africa [13,15,30,41].

The mean birth weight of newborns (3118.48 ± 515.39g) in this study, is higher than those found in Burkina Faso, Ethiopia and Ghana, which were 2914g, 2600g and 2669g respectively [31,32,35]. A positive association was found in multivariate linear regression between some maternal anthropometry characteristics, dietary diversity and birth weight after adjusting for educational level of mother, well-being index and alcohol consumption during pregnancy. Women with medium and higher dietary diversity score gave birth to heavier babies compared to women with low dietary diversity score ($p = 0.017$ and $p = 0.036$, respectively). This could be explained by the fact that women of adequate dietary diversity (≥ 4 food groups) also consumed nutrient-rich foods, such as milk and dairy products, eggs, fruits and vegetables. These results are in line with those of Saaka,[12] and Zerfu *et al.*[14] which showed that the dietary diversity score has a positive impact on birth weight. Thus, inadequate dietary diversity has been associated with a high risk of premature delivery and low birth weight [14].

In addition, lack of dietary diversity is strongly associated with inadequate intake and risks of essential micronutrient deficiencies [42]. Such insufficient nutrient intakes during pregnancy would result in irreversible damage to the fetus that can compromise survival and subsequent health. As a result, a low dietary diversity score has been identified as a major determinant of adverse pregnancy outcomes [42]. Indeed, the mean number of food groups consumed in this study was 4.2, and almost 70% of them had consumed foods from at least four food groups (Table 2).This is in accordance with those reported by Kouassi et al [24] during the food vulnerability survey in Abidjan. This could be due to the fact that most of the study participants (about 65%) were engaged in an activity that allowed them to earn money, which would then allow them to purchase a greater variety of food. Indeed, low purchasing power limits the consumption of certain food groups such as fruits, vegetables and animal source food [43]. Similarly, the level of education of women in this study could affect their knowledge and practices regarding dietary diversity. This finding is also supported by the study by Aliwo *et al*.[44] which showed that the probability of adequate dietary diversity practice was twice as high among educated pregnant women as among those with no formal education. One could then say that education contributes to the knowledge of the importance of a diversified diet.

In short, nutritional status including maternal nutrition strongly influences birth weight [12,14,15]. Therefore, the challenge for the health authorities of these public health facilities is to develop strategies that would improve access to information on dietary diversification during routine prenatal care (ANC) contacts for women of reproductive age, particularly pregnant women. Contrary to these results, Poon *et al.*, [45] found no relationship between birth weight and maternal diet.

It is clear from Table 5 that gestational weight gain and maternal height were the major maternal factors significantly associated with birth weight. Indeed, large women (> 1.55m) had babies with a significantly higher birth weight (p=0.004) than small women (≤ 1.55m). Studies by Morrison *et al.*, [18] and Tabrizi and Saraswathi,[19] have previously found a strong correlation between mother height and birth weight of newborn. The same is true for gestational weight gain. Mothers with high gestational weight gain (> 7kg) gave birth to children with higher birth weight (p = 0.000) compared to children of mothers with low gestational weight gain (≤ 7kg). Similar results have been reported in many studies [20, 21].. This could be explained by the positive correlation (r = 0.356; p = 0.002, results not shown) between the gestational weight gain of the women in this study and the dietary diversity score; which would have helped the newborn to gain more weight.

The well-being index in this study had no significant influence on baby weights at birth as in the work of Tabrizi and Saraswathi, [19] in Iran and Atuahene *et al.*, [46] in Ghana. Nevertheless, results contrary to ours have been observed elsewhere [14,15].

Women's level of education was also not a direct predictor of birth weight. These results are consistent with those of other authors [35,19,46] who found that educational attainment did not have a significant effect on birth weight.

5. CONCLUSION

At the term of this study, which established the effect of maternal anthropometric and nutritional characteristics on the birth weight of the newborn, it was demonstrated that the mean birth weight in the maternity hospitals of Abobo-Té, Anono-Riviéra 2 and Yopougon Attié was 3118.48 ± 515.39 g. This birth weight was significantly higher for boys than girls. In addition, the reality of the cycle of mother-child malnutrition among adult mothers (20 to 42 years of age) was highlighted by the presence of both low weight (7.6%) and excess weight (5.5%) at birth in Abidjan, and particularly in the maternity hospitals of the municipalities of Abobo, Cocody and Yopougon.

Considering maternal factors associated with birth weight, the study demonstrated that high gestational weight gain, high maternal stature and adequate dietary diversity had a positive effect on birth weight of newborn. Women with gestational weight gain greater than 7 kg, high stature (>1.55 m) and an adequate dietary diversity score (≥ 4 food groups) had babies with significantly higher mean birth weights than other women's children after adjusting for mother's education level, well-being index and alcohol consumption in current pregnancy.

These results suggest that particular emphasis should be placed on nutritional education and body weight management during pregnancy. Further follow-up studies from early pregnancy to childbirth should be conducted.

CONSENT

All authors declare that written informed consent was obtained from the subjects for publication of this research paper and accompanying images.

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. Ethical approval was given by the local Ethics committee (**N/Ref: 126-18/MSHP/CNESVS-km)**

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