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Research Article

Relationship of Couple Mother-Newborn in Burkina Faso: Underweight at Birth Risk Factors Case

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Abstract

Background: Weight measure before and during pregnancy is an indicator of a mother's health and nutritional status, and the developing fetus.

Objective: The objective of this study was to find the risk factors of underweight at birth.

Methods: Prenatal consultation and delivery registers of health centres were used to fill the questionnaire previously established for this purpose. A Total of 1115 couples' mothers-newborns were identified. Twins and premature babies were excluded. The main dependent variable was underweight at birth. The WHO growth standards for children born at term were used. The association between two qualitative variables were studied and chi-square test used at 5% significance level. Multinominal logistic regression was used to determine the risk of underweight at birth.

Results: According to the summary statistics, the average weight at the first prenatal consultation, the average height, age and MUAC of the mothers were 56.3 ± 7.7 kg, 162 ± 5.7 cm, 26.2 ± 6.2 years, 253 ± 18.6 mm respectively. With respect to newborns, the average birth weight was 2.9 kg. The average head circumference was 32.6 cm and of these newborns, 20% suffered from microcephaly and 11.1% suffered from underweight at birth. The underweight at birth affected more females (14.2%) than males (8.0%) with a significant difference of P = 0.001. Teenagers' mothers, whose weight were 40 Kg and were 1.5 metres in height were more at risk to have underweight babies at birth.

Conclusion: The vicious cycle of intergenerational malnutrition still persists and should be addressed seriously.

Keywords: Underweight at Birth; Malnutrition; Pregnancy; Newborns; Burkina Faso

Abbreviations

UWB: Underweight at birth; MUAC: Mid-upper arm circumference; WHO: World Health Organization; BMI: Body Mass Index; HC: Head circumference; ROC: Receiver Operating Characteristic; PC: Prenatal consultation

Introduction

Pregnancy is a dynamic and anabolic process characterized by physiological changes related to fetus development, maternal tissue growth, to the maintenance of maternal homeostasis and preparation for breastfeeding [1]. The physiological needs of pregnancy require regular and balanced input provided by feeding and maternal reserves. Evaluation of the maternal nutritional status during pregnancy is based on height, weight, mid-up arm circumference (MUAC) and various other measures.

Weight gain is an indicator of the development of the fetus, of the health and nutritional status of the mother. Underweight at birth (UWB) is defined by the World Health Organization (WHO), as a birth weight strictly less than 2500 gram (g), regardless of the pregnancy term [2]. Studies have shown that the risk of UWB decreases when the gestational weight gain increases. Inadequate ma-

ternal weight gain is associated with a risk of intrauterine growth delay, prematurity, UWB, morbidity and perinatal mortality. A small birth weight is a predictor of mortality and morbidity [3]. The child birth weight is an indicator of the health and nutritional status of the mother before and during pregnancy [4].

According to recent observations, MUAC can be used as an indicator of nutritional status of women outside pregnancy, due to the high correlation degree with weight and weight for height [5].

MUAC reflects past growth and current nutritional status. It can also be used during pregnancy to find a risk of UWB and late fetal mortality or infant mortality [6]. MUAC is relatively stable during pregnancy in developing countries and is independent of gestational age.

The height is a good indicator of the socio-economic situation and to identify women at nutritional risk. As such, it can be of interest for targeted nutritional intervention [7].

A good nutritional status is essential for pregnancy to have a favorable outcome. Maternal nutrition is a fundamental determinant of fetal growth, weight birth and infant morbidity [8-10].

A low body mass index (BMI), the overweight or small height in women have harmful effect on their pregnancy outcome.

Weight gain during pregnancy including the 2nd and the 3rd quarter is also a predictor factor of the maternal and fetal outcome. Teenage pregnancy has been associated with an increased risk of premature birth, low birth weight, small children for gestational age, and an increased risk of neonatal mortality [11]. Early or advanced maternal age is significantly associated with risk of adverse outcomes such as birth of stillborn, low birth weight and premature babies [12].

Most developed countries do face excessive gestational weight gain, and on the contrary, very little data exist in developing countries, particularly in Burkina Faso to ascertain gestational weight gain levels. According to the demographic and health survey in 2010, 16% of women procreation age in Burkina Faso are affected by a chronic energy deficit (BMI <18.5) and 58% of pregnant women are affected by anemia [13]. The outcome of the pregnancy for the mother and the child is indisputably linked to maternal nutritional status measured by anthropometry or biochemistry. It is anticipated that simple physical measures can help identify individuals, families and communities who will benefit from interventions whose goal will be to improve the nutritional status and overall health in general, to improve survival of newbons. This study has therefore been conducted and come at an opportune time to address these challenges.

Methods

Study framework

Burkina Faso is a country in West Africa with an area of 272 967.47 km^2, and bounded to the north and west by Mali, to the east by Niger and to the south by Benin, Togo, Ghana and Côte d'Ivoire. Administratively, the country is divided into 13 regions, 45 provinces, 350 departments, 351 municipalities and 8228 villages.

The study was conducted in the centre-west region of Burkina Faso, located 100 kilometers from Ouagadougou, the capital. This region includes the provinces of the Boulkiemdé, Réo, Sissili, and Ziro with a total population estimated in 2016 at 1 554 040 inhabitants [14]. The poverty index of this region was 41.3% in 2011 and it was the seventh poorest region in the country [15].

At the centre-west region in 2016, the prevalence of acute malnutrition, chronic malnutrition and underweight were 8.8%, 25.1% and 19.0% respectively [16].

Type and population study

This was a cross-sectional study and both descriptive and further statistics were applied to the data collected. The study population consisted of couples' mothers-newborns.

Sampling

A systematic random sampling method was used to select 15 health centres in the centre-west region. Following this, the number of couples mothers-newborns that were selected was based on the number of alive newborns in each health centre during year 2017. Based on this survey, a total of 1115 couples' mothers-newborns were selected.

Inclusion and exclusion criteria

Mothers who had been unable to do at least three prenatal consultations before childbirth were excluded from the study, including their children. Couples' mothers-newborns with some fundamental missing data were excluded. Also, twins or premature newborns were excluded including their mothers.

Study variables

The study variables were weight, height, mid-up arm circumference (MUAC), age and the number of mother prenatal consultations (PC). The height of a woman is a good predictor of the pregnancy outcome. Weight change reflects recent events. The MUAC is useful for assessing acute malnutrition in adults and to assess the prevalence of malnutrition in the population level. The MUAC is independent of pregnancy or breastfeeding, and it can be used as an effective indicator of a woman's nutritional status throughout her childbearing years. In the newborn, the variables were weight, head circumference (HC) and his parents' place of residence. The main dependent variable was underweight at birth (UWB).

Methods and data collection tools

Health officers of 15 health centres selected and trained have contributed to the collection of anthropometric data of women and newborns. The data collection took place from 22 to 28 February 2017. Prenatal and delivery registers of health centres have been used to fill in the questionnaire previously established for this purpose. In the review of the tools used for data collection, it was refreshing to note a good availability of anthropometric equipment in selected health centres.

The mother's height was measured with a SECA fathom in a standing position, graduated in millimeters (mm) and maximum range of 220 centimeters (cm). The height of the subjects was measured without shoes and scarves in their early pregnancy. The weight of women was measured at each prenatal consultation without shoes and heavy clothing using an electronic UNISCALE balance, with a precision of 100 gram (g) and a maximum range of 150 kilograms (kg). The mothers MUAC has been measured at the left arm half distance to the tip of the elbow and the tip of the scapula with a tape graduated in millimetre, flexible but not expandable.

The MUAC was measured at each visit, but its value to the first consultation was used to assess the mother's nutritional status. The age of mothers was determined through their identification document. The birth weight is the first weight measurement carried out in the newborn just after childbirth. The weight of newborns was measured at birth using an electronic scale SECA, to an accuracy of 100 g with a maximum range of 25 kg. The newborns' head circumference has been measured using a tape measure, flexible, non-stretch to a millimeter closely above the eyebrows and ears in less than 24 hours after the birth.

Ethics considerations

The study protocol was approved by the ethics committee of the health research in Burkina Faso. At the regional level, a clearance was obtained at health direction for the data collection. At each health centre, informed consent was obtained from the lead.

Data treatment and analyse

After entry and clearance, data analysis was performed using the IBM SPSS Statistics software for Windows, version 20 [17].

The WHO growth standards for children born at term were used for head circumference measurement [18].

Newborns whose head circumference was less than two standard deviations were considered as presenting microcephaly. Infants whose birth weight was less than 2.5 kg were regarded as suffering from underweight [19].

Mothers whose height was less than 155 cm were considered small. Mothers whose MUAC was less than 230 mm were considered to be referred to as thinness [20,21].

A descriptive analysis was conducted to describe the different characteristics of mothers and newborns. The estimated proportions were presented with at 95% confidence intervals. The association between two qualitative variables was applied using the chi-square test at 5% significance level. Multinominal logistic regression was employed to determine the risk of underweight at birth of newborns. The reference category is the normal nutritional status of infants. The top-down procedure was used for the final model choice and based on Wald test at 5% statistical significance.

Results

Based on the summary statistics (Table 1), averages of the following variables at first consultation: height, age and that of MUAC of the mothers were, 56.3 ± 7.7 kg, 162 ± 5.7 cm, 26.2 ± 6.2 years, 253 ± 18.6 mm respectively. The average weight at the last prenatal consultation was 60.5 ± 7.9 kg. The proportion of mothers of small height in this study (height < 155 cm) was 12.1%.

Variables	Mothers						Newborns	
	Number of PC	Weight at first PC (kg)	Height (cm)	Age (year)	MUAC (mm)	Weight at last PC (kg)	Weight (kg)	HC (cm)
n	1115	1115	1115	1115	1115	1115	1115	1115
Mean	3.8	56.3	161.9	26.2	253.3	60.5	2.9	32.6
IC at 95%	3.7	55.7	161.6	25.8	252.2	60.1	2.9	32.4
	3.9	56.8	162.3	26.6	254.4	61.2	2.9	32.6
Median	4.0	55.0	162.0	25.0	250.0	60.0	2.9	33.0
SD	0.7	7.7	5.7	6.2	18.6	7.9	0.4	2.1
Minimum	3	25	142	14	128	38	0.9	21
Maximum	6	98	188	45	370	102	5.0	50

Table 1: Anthropometric data of mothers and newborns.

SD: Standard Deviation IC: Interval of Confidence PC: Prenatal Consultation, HC: Head Circumference MUAC: Mid Up Arm Circumference

With regards to newborns, the average weight at birth was 2.9 kg. The proportion of girls (50.6%) to boys were almost.

The average head circumference of newborns was 32.6 cm. In addition, 20% of the newborns suffered from microcephaly.

The results show that 69.5% of the mothers were less than thirty years of age. About 95% of them had a good nutritional status based on the results from the MUAC compared to the 5% who had bad nutritional status. It was also clear that 87.9% of mothers were more than 155 cm in height and 98.2% had their weight at first consultation, between 41 to 79 kg. It was also clear that 83% of them had given birth in the four first prenatal consultations (Table 2).

The proportion of newborns who had at least 2.5 kg of body weight was 89%. The finding also showed that 11.1% of newborns were underweight (Table 2).

Characteristics of mothers	Modalities	n (%)
Age (year)	≤ 19	174 (15.6)
	20-29	601 (53.9)
	30-39	307 (27.5)
	40-49	33 (3.0)
MUAC (mm)	≤ 230	55 (4.9)
	> 230	1060 (95.1)
Height (cm)	≤ 155	135 (12.1)
	> 155	980 (87.9)
Weight at first PC (kg)	≤ 40	7 (0.6)
	41-59	792 (71.0)
	60-79	303 (27.2)
	≥ 80	13 (1.2)
Weight gain during pregnancy (kg)	≤ 5	793 (71.1)
	> 5	322 (28.9)
Number of PC	≤ 4	925 (83.0)
	≥ 5	190 (17.0)
Characteristics of newborns		
Weight at birth (kg)	< 2.5	124 (11.1)
	≥ 2.5	991 (88.9)
Head circumference (cm)	Microcephaly	224 (20.1)
	Normal	891(79.9)
Sex	Male	551 (49.4)
	Female	564 (50.6)
Province	Boulkiemdé	534 (47.9)
	Sanguié	122 (20.1)
	Sissili	224 (21.1)
	Ziro	235 (10.9)

Table 2: Characteristics of the couples' mothers-newborns.

PC: Prenatal Consultation; MUAC: Mid Up Arm Circumference

The mother's weight at the first prenatal consultation was associated with the newborns' nutritional status with a significant statistic of P = 0.013 (Table 3).

The mothers' height was associated with the newborns' nutritional status with a significant statistic of P= 0.020. The mothers' age groups were associated with the newborns' nutritional status with a significant statistic of P= 0.008. It was generally observed that less newborns suffered from UWB when the number of mothers' prenatal consultation increased. These differences were not significant (p > 0.05).

Furthermore, the UWB was found in female newborns (14.2%) than males (8.0%) with a significant difference (P = 0.001). Nearly 32% of newborns with UWB were also observed to suffer from microcephaly (low head circumference). Within Ziro and Réo provinces newborns were more affected by UWB compared with other provinces with significant difference of P= 0.029 (Table 3).

Characteristics of mothers	Modalities		Underweight at birth		P
		n	Yes n (%)	No n (%)	
MUAC (cm)	≤ 230	55	6 (10.9)	49 (89.1)	0.789
	> 230	1060	118 (11.1)	942 (88.9)	
Age tranche (year)	<= 19	174	32 (18.4)	142 (81.6)	0.008
	20 - 29	601	63 (10.5)	538 (89.5)	
	30 - 39	307	26 (8.5)	281(91.5)	
	40 - 49	33	3 (9.1)	30 (90.9)	
Height (cm)	≤ 155	135	23 (17.0)	112 (83.0)	0.020
	> 155	980	101 (10.3)	879 (89.7)	
Weight at first PC	≤ 40	7	2 (28.6)	5 (71.4)	0.013
	41-59	792	101 (12.8)	691 (87.2)	
	60-79	303	20 (6.6)	283 (93.4)	
	≥ 80	13	1 (7.7)	12 (92.3)	
Weight gain (kg)	≤ 5	793	82 (10.3)	711 (89.7)	0.193
	> 5	322	42 (13.0)	280 (87.0)	
Number of PC	≤ 4	925	108 (11.7)	817 (88.3)	0.194
	≥ 5	190	16 (8.4)	174 (91.6)	
Characteristics of newborns					
Sex	Male	551	44 (8.0)	507 (92.0)	0.001
	Female	564	80 (14.2)	484 (85.8)	
Head circumference	Microcephaly	224	71 (31.7)	153 (68.3)	0.000
	Normal	891	53 (5.9)	838 (94.1)	
Province	Boulkiemdé	534	52 (9.7)	482 (90.3)	0.029
	Sissili	224	18 (8.0)	206 (92.0)	
	Ziro	235	36 (15.3)	199 (84.7)	
	Sanguié	122	18 (14.8)	104 (85.2)	

Table 3: Associated factors of underweight of newborns.

MUAC: Mid Up Arm Circumference, PC: Prenatal Consultation

Compared to girls, boys are 42% less likely to be underweight at newborn (OR: 0.58; P: 0.014). Children with microcephaly were 12 times more likely to have low birthweight than those with normal head circumference. Children from the Sissili province were 73% less likely to be underweight at birth (OR: 0.27; P: 0.002) than those from the Sanguié province (Table 4).

Teenage mothers were twice at risk to have an underweight newborn than other mothers, however, this difference was not significant (P= 0.215). Mothers who had at most 40 Kg on the first prenatal consultation were three times more likely to have a newborn suffering from underweight than those who weighed more, even if this difference was not significant (Table 4).

Characteristics of mothers		OR (confidence interval 95%)	P-value
Age (year)	<= 19	1.762 (0.413-7.924)	0.444
	20 - 29	1.077 (0.262-4.425)	0.918
	30 - 39	0.901 (0.210-3.860)	0.888
	40 - 49®	1	
Weight at first PC	≤ 40	3.359 (0.186-60.509)	0.411
	41-59	1.406 (0.150-13.199)	0.765
	60-79	0.808 (0.083-7.841)	0.854
	≥ 80®	1	
Height (cm)	≤ 155	1.392 (0.788-2.458)	0.255
	>155®	1	
Number of PC	≤ 4	1.308 (0.696-2.456)	0.404
	≥ 5®	1	

Weight gain (kg)	≤ 5	0.723 (0.459-1.141)	0.163
	> 5®	1	
Child's sex	Male	0.584 (0.381-0.896)	0.014
	Female®	1	
Child's head circumference	Microcephaly	11.748 (7.369-18.730)	0.000
	Normal®	1	
Province	Boulkiemdé	1.056 (0.535-2.083)	0.875
	Sissili	0.273 (0.122-0.613)	0.002
	Ziro	1.660 (0.793-3.473)	0.179
	Sanguié®	1	

Table 4: Risk of UWB and the characteristics of the couples' mothers-newborns.

OR: Odds Ratio, ®: reference.

Discussion

The average weight of the mothers in this study was lower than that found in 2013 in Burkina Faso which was 59.0 kg [22]. This difference is explained by the fact that the age groups are not the same; 15 to 45 years for this study compared to 25 to 64 for the 2013 figures. However, the average height of the mothers was identical based on the level of these two studies.

The average height of the mothers in this study was slightly higher than that of adolescents from 15 to 17 years (158.25 cm) at Nanoro in Burkina Faso in 2012 [21].

The height of the mothers being associated with the width of the basin, the mothers who were small in height were exposed to obstetric complications during pregnancy and childbirth.

The average age of the mothers in this study is higher than that national 21.9 [23]. She is almost identical to one found at West of Algeria in 2013 which was 26.77 ± 6.44 years [12].

Based on the MUAC findings of the mothers in this study, 5% of them suffered from undernutrition. Several studies have confirmed that undernutrition of pregnant women contributes to the increased risk of infection, anemia and negative outcomes of childbirth [24].

The proportion of newborns who suffered from underweight from this study was low compared to the results found in a referral medical centre in the Democratic Republic of the Congo [25]. This could be due to the actual performance of the activities of disease prevention in the respective health centres. Indeed, there were 3924 and 4227 sessions on information, education and communication respectively on nutrition and infant and young child feeding made at the regional level in 2016 for the benefit of women [26].

The authors found in Algeria [12], in Tunisia [27], at Conakry [28] and at Lubumbashi [29] lower proportions (5.53%, 5.1%, 7.33% and 6.4% respectively) compared to this study. This difference based on the fact that Algeria, Tunisia and DR Congo are more developed than Burkina Faso and the Conakry study was carried out in hospital.

The chances of survival of a newborn are closely associated with their birth weight. The mortality and morbidity rates are higher in newborns of low weight at birth (< 2,5 kg) than among those whose weight at birth is normal [30].

The anthropometric measurement of the mothers such as weight, height, and age were associated with the nutritional status of the newborns. Furthermore, MUAC and the number of mother's prenatal consultations were weakly associated with nutritional status of the newborns. The proportion of underweight newborns was highest in maternal age group under 30 years. Other authors had found these same results [12,31].

The high number of mothers' prenatal consultation was favourable for newborn growth.

It was observed that some pregnant women do not like to visit the health centre as expected until child birth. For example, in 2016, the coverage rates at first, two and four prenatal consultation were 70.4%, 64.2% and 34.5% respectively in the Centre-West region [26]. It does not strengthen the follow-up to maintain a good nutritional status of the pregnant until the end of the pregnancy. Indeed, one author noted in 2017 that the empowerment of women through health education improves the growth of children [32].

The UWB was found more in female newborns than males. The predominance of female newborns with low birth weight, was consistent with the data in the literature [25]. Nearly one newborn in three suffered from UWB and microcephaly. The microcephaly condition can be corrected through the food supply of these children. Indeed, one author noted in 2017 that exclusive breastfeeding was known to improve head circumference growth [32]. Another author noted that the 1000 days period is a window of opportunity for physical, mental and social development [33].

In some Provinces, newborns were more affected by the UWB compared to others. Other authors have pointed out a regional disparity in development of newborns even in developed countries [34].

Mothers who had 19 years or below in age, 40 Kg or below and who measured 155 cm or below had the most risk of having underweight newborns than other mothers outside these parameters. Some previous studies confirmed this [29,35].

Strengths and Limitations

A strength of this study can be put down to the high-quality anthropometric data collected from the health centres with the assistance of a good and efficient technical team.

This study has limitations that should be considered.

The sample was not perfectly representative of the population because there was always a minority of pregnant women who still gave birth at home. MUAC threshold values were observed to fluctuate from one ethnic group to the other.

It would be more appropriate to use another study to collect data at the national level and use Receiver Operating Characteristic (ROC) statistical analysis to determine a mother's MUAC threshold for women undernutrition.

Conclusion

This study confirms the existence of an intergenerational cycle of malnutrition that is important to break as soon as possible. As confirmed by several studies, mortality and morbidity rates were highest in UWB newborns than those whose weight at birth was considered normal. Although there was an identical proportion of girls and boys, the UWB was significantly more in females than male newborns. There was a weak positive linear correlation between MUAC, weight and height of the mothers. It means that anthropometric measures must be take independently to know a broader situation of the nutritional status of women.

Many efforts could made towards the provision of information, education and communication on early pregnancy, the women adequate food consumption in general and especially pregnant women to reduce the proportion of newborns with underweight. More attention should be given to women who have at most 40 kg, height less than 155 cm or MUAC less than 230 mm.

Data Availability Statement

The data used in this study can be provided by the corresponding author upon reasoned request.

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Conflicts of Interest

The authors declare that they have no conflicts of interest.

Authors' Contributions

O. O., E. W. R. C. designed and carried out the study. O. O., E. W. R. C. participated in the collection, analysis and interpretation of the data. O. O., E. W. R. C. wrote the manuscript. F. B. Z. made the critical revisions of the article. The final article is approved by M. H. D. All authors have read and approved the final manuscript.

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