World Journal of Public Health
2024; Vol. 9, No. 1, pp. 74-85
https://doi.org/10.11648/j.wjph.20240901.20

Research Article

Study of Factors Associated with Low Birth Weight in the Bounkiling Health District in 2020 (Senegal)

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Abstract

Introduction: Neonatal mortality is particularly high in developing countries. Low birth weight (LBW) is a major public health problem in both developing and developed countries. It accounts for a significant proportion of neonatal deaths. The aim of this study was to determine the factors associated with the occurrence of low birth weight in the Bounkiling health district in 2020. *Methodology*: This was a retrospective case-control study of the various factors associated with low birth weight, based on women's delivery records from maternity units in the Bounkiling health district throughout 2020. Mothers' socio-demographic characteristics, obstetrical and medical history, and information on the health status of the newborn in the case group (weight less than 2,500 grams) were compared with those in the control group (weight greater than or equal to 2,500 grams). Bivariate and multivariate analyses were performed using Épi info 7 software to identify risk factors associated with LBW. *Results*: The study showed that low birth weight accounted for 97.05% of LBW, the sex ratio was 0.87 in favor of girls, the Apgar score at birth was not good (below 7) for 31.43% of newborns. Teenage mothers accounted for 17.08%. Women with no schooling accounted for 71.34%, and those living in households with a monthly income of less than 50,000 CFA francs per month were 63.71%. Results of the multivariate analysis showed that the risk factors for LBW ($p < 0.05$) were female sex of the newborn (AOR=1.59 with CI=1.07 - 2.35), Apgar score at birth (AOR=2.79 with CI=1.77 - 4.41), young maternal age under 19 (AOR=2.42 with CI=1.43-4.12), household income under 50,000 CFA francs, (AOR=1.97 with CI=1.27-3.04), maternal history of low birth weight (AOR=3.62 with CI=2.02-6.50), physical labor during pregnancy (AOR=1.80 with CI=1.20 - 2.69). *Conclusion*: Improving neonatal health through a reduction in LBW will depend on intensifying the implementation of strategies focused on adolescent reproductive health, strengthening communication with adolescent girls and community leaders on the issue of early marriage and pregnancy, improving pregnancy monitoring at health facilities and raising the socio-economic level of women through their empowerment.

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Received: 7 February 2024; **Accepted:** 28 February 2024; **Published:** 13 March 2024

Keywords

Low Birth Weight, Associated Factors, Bounkiling, Senegal, 2020

1. Introduction

Infant mortality remains a major concern worldwide. It is particularly high in developing countries, where it is dominated by deaths in the neonatal period [1].

Neonatal mortality remains a major public health problem, accounting for over 60% of deaths among newborns before their first birthday [2]. Nearly 6.3 million children died before the age of 5 in 2013 [3]. Despite the efforts made by countries, neonatal mortality remains high, dropping from 36.6 per thousand in 1990 to 17.5 per thousand in 2019 [4].

This neonatal mortality rate is particularly high worldwide, due in part to the high number of deaths among low-birth-weight infants [4]. Low birth weight (LBW) is defined by the World Health Organization as a birth weight strictly below 2500g, regardless of the term of pregnancy [5]. Low birth weight is a major public health problem in both developed and developing countries [5]. In developing countries, the proportion of LBW is twice as high as in developed countries [6]. Low birth weight is also a predictive factor for poor child survival. Moreover, they are responsible for the mortality of 9.1 million children worldwide every year. [6]. Between 1997 and 2001, World Health Organization (WHO) and United Nations Children's Fund (UNICEF) carried out a census of all births worldwide, based on national data and registers. According to this report, of the 130 million children born worldwide each year, 20 million are born with LBW, representing an overall prevalence of 15.5%. [7]

Indeed, various studies have shown that low-birth-weight newborns have higher mortality and morbidity rates than children of normal weight. [8]

In 2015, 20.5 million children came into the world weighing less than 2,500 grams, or around one in seven births worldwide. Almost 90% of these births take place in low- and middle-income countries, particularly in South Asia and sub-Saharan Africa [9]. More than 80% of the 2.5 million newborns who die each year worldwide suffer from low birthweight because they are premature at birth or small at gestational age [9].

Low-birth-weight babies who survive are at greater risk of stunted growth, impaired physical and mental development and poor physical health later in life, including chronic diseases such as diabetes and cardiovascular disease [9].

In the literature, several risk factors or causes are associated with low birth weight. These include prematurity and intrauterine growth retardation, or a combination of the two. In industrialized countries, the main cause of low birthweight is prematurity. Other intermediate factors are mentioned, such as poor nutrition, high prevalence of infections, pregnancy complications or unfavorable working conditions for women [10].

The WHO estimates that newborns with LBW represent 17% of all live births. This frequency varies from country to country, ranging from 7% in developed countries to 19% in developing countries [6]. In sub-Saharan Africa, the prevalence of low birthweight varies from country to country with, for example, 13% in Cape Verde, 15% in Togo, 16% in Benin, 19% in Burkina Faso and 23% in Mali [7]. In Senegal, the proportion of low birthweight babies fell from 18% to 12% between the demographic and health surveys carried out in 2000 and 2017 respectively. In the Sédhiou region, it is 11.7% with data from the 2017 continuous Demographic and Health Survey (DHS) [11].

In the Bounkiling health district, administrative data showed that the number of children born with low birth weight in health structures was below the data provided by demographic surveys. The proportions ranged from 7.35% in 2019 to 10.3% in 2020 of all live births recorded in health structures in the Bounkiling district. [12].

Low-weight newborns, and more particularly premature babies, require rigorous management that is difficult to achieve, especially in semi-rural and rural areas due to under-equipment and a shortage of qualified personnel. Our aim was therefore to study the factors associated with the occurrence of LBW in the Bounkiling health district, with a view to improving maternal and child health.

2. Study Area

The study was carried out in the Bounkiling Health District, which corresponds administratively to the department of the same name. It is located in southern Senegal, 345 km from the capital Dakar. It covers an area of 3,005 km2. The climate is Sahelian, with a wet season from June to October, with average rainfall of 600 and 1,350 mm. In 2020, the official population according to the National Agency for Statistics and Demography (NASD) was 18,3842, representing a density of 62 inhabitants per Km². The geographical distribution of the population in relation to health facilities is as follows: 61% of the population is less than 5 km from a health facility, 31.5% of the population between 5 and 15 km from a health facility et 7.50% of the population more than 15 km from a health facility. In total, 152588 people lived in rural areas, i.e. 82.9% of the total population. The Total Fertility Rate (TFR) for the Sédhiou region is one of the highest in the country, at 6.4 children per woman. The population is cosmopolitan, made up of Man-

dingo (50%), Diola (25%), Peulh (15%) and various other ethnic groups: Ba ïnouck, Mandjack, Mancagnes, Diankhank és, Sarakol és, Wolofs, S ér ères (10%). The main economic activities in the Bounkiling department are: agriculture, sedentary livestock farming and trading. Traditional medicine, which includes the practices of healers and marabouts, is very much in evidence. The problem of low birth weight is still with us in 2020, in the Bounkiling health district, despite the efforts made to improve the availability of services and the living conditions of the population. With the support of technical and financial partners, the Ministry of Health and Social Action has focused on a number of strategies to improve maternal and neonatal health: These include nutrition enhancement activities through the Nutrition Enhancement Program, the United Nations Population Fund (UNFPA) project, which focuses on maternal and newborn health, and the mobile unit strategy of the United States Agency for International Development (USAID) and Marie Stopes International (MSI), support for integrated mobile strategies, the USAID "NEEMA" project, support for the AMREF (African Medical and Research Fundation) project focusing on adolescent reproductive health, and the establishment of support groups ("Bajenu Gox", community watch and alert committees).

3. Materials and Methods

3.1. Type of Study

This was a retrospective case-control study of the various factors associated with low birth weight, based on women's delivery records from maternity units in the Bounkiling health district throughout 2020.

3.2. Study Population

The study population is made up of all mothers who have given birth in the health facilities of the Bounkiling health district, and the newborns resulting from these deliveries. Two groups of mother-child pairs were formed in our study: cases and controls:

1) A case (low weight) was defined as any newborn whose birth weight was less than 2500 grams, on a baby scale.
2) A control (normal weight) was defined as any newborn whose birth weight was greater than or equal to 2500 grams.

The control newborn was randomly selected from among children born just before or after the low-weight newborn.

3.3. Sampling

3.3.1. Selection Criteria

Inclusion criteria for cases

1) All live newborns, delivered in maternity units of the Bounkiling health district, weighing less than 2500 grams, during the study period.
2) All women who delivered live newborns weighing less than 2,500 grams in the maternity units of the Bounkiling health district during the study period.

Inclusion criteria for controls

1) All live newborns, delivered in maternity units of the Bounkiling health district, weighing more than 2500 grams, during the study period,
2) All women who delivered live newborns weighing 2500 grams or more in the maternity units of the Bounkiling health district during the study period,

Non-inclusion criteria

In this study, the following were not included:

1) All live newborns whose birth weight was not found in the records.
2) All women with incomplete or untraceable delivery records.

3.3.2. Sample Size

In this study, we proceeded with an exhaustive sampling of all low-birth-weight newborns whose deliveries took place in the health facilities of the Bounkiling health district during the year 2020, i.e. 269 low-birth-weight babies.

We excluded from this study:

1) 13 cases of low-birth-weight newborns in twin pregnancies,
2) 5 cases of low-birth-weight newborns whose mothers lived outside the study area
3) 14 cases of low-birthweight newborns with missing data (no report of newborn weight, mother's age or socio-economic factors).

In the end, we ended up with a total of 237 eligible low-birth-weight files.

These 237 low birthweights were matched with 237 births weighing 2500 grams or more.

3.4. Variables Collected in Our Study

3.4.1. Independent Variables

These consist of socio-demographic characteristics, the mother's history and information on the condition of the newborn.

Maternal sociodemographic characteristics:

1) maternal age
2) parity (primiparous and multiparous),
3) marital status
4) the notion of consanguineous union,
5) professional occupation
6) level of education
7) place of residence
8) number of prenatal consultations during pregnancy,
9) gestational status

Maternal antecedents

1) notion of low birth weight,

2) abortion or stillbirth,
3) maternal pathologies such as diabetes, HIV infection, malnutrition, anaemia during pregnancy, hypertension, malaria
4) alcohol consumption or use of "intra-vaginal tobacco" during pregnancy
5) the notion of geophagy during maternity.

Maternal malnutrition was defined by a body mass index < 18.5 kg/m^2; anemia was established on the basis of a hemoglobin level below 11 g/L

Gestational hypertension was defined by a blood pressure ≥ 140/90 mm Hg.

3.4.2. Dependent Variable

Birth weight, transformed into a binary variable (< 2500 grams and ≥ 2500 grams), was considered here as the dependent variable in our study.

3.5. Data Collection

3.5.1. Data Collection Tools

Data were collected using a form, the various parts of which are the women's socio-demographic characteristics, maternal history, pregnancy pathologies, and the newborn's clinical examination.

3.5.2. Data Collection Methods

Information was collected from the delivery records of women who had given birth to low-weight babies in the case group, and those of women who had given birth to normal-weight babies in the control group.

It is completed by a field visit to selected women for whom health records are also used.

3.6. Data Entry

Data was entered using sphinx software, then exported to Epi info TM 7. This stage was preceded by a data quality check to verify the consistency of the information collected.

3.7. Data Analysis

Data analysis was based on the same software and comprised two parts: descriptive and analytical.

Descriptive part

For categorical variables, the descriptive part consisted in determining the relative frequency with 95% confidence interval, and for quantitative variables, in calculating positional parameters (mean, median, mode, etc.) and dispersion parameters (standard deviation and range).

Analytical part

Bivariate analysis was performed using the following statistical tests: Chi ²for comparison of proportions and Fisher's exact test. A difference was considered significant when the p was less than 0.05. The Odds ratio (OR) and its confidence interval (CI) were used to quantify the strength of the association. This bivariate analysis enabled us to identify the risk factors associated with the occurrence of low birth weight in the Bounkiling health district.

The ORs calculated in this way are referred to as "crude" or "unadjusted".

To control for possible confounding factors, a multivariate analysis using logistic regression was performed. Simple logistic regression was used to model the factors associated with low birth weight. In this analysis, variables that are significantly related to the variable to be explained are retained in the model. Variables whose significance was less than or equal to 0.25 in the bivariate analysis were included in the initial logistic regression model. The automated top-down selection procedure was used to build the final model. The likelihood ratio test was used to compare the fit of the nested models (13). Model fit was investigated using the Hosmer and Lemeshow test (14).

3.8. Ethical Considerations

From an ethical point of view, the information provided in the study was confidential and kept in a safe place in the Bounkiling Health District. The women selected will not be identified in the results and presentation of the data. Their names will not appear on any documents.

Participation in the study for those surveyed was free and voluntary. An informed consent form was proposed to participants, read and approved. It provided all the information needed to understand and decide whether or not to participate. No incentive, financial or material compensation was offered to participants.

3.9. Limits

Our study is limited by the incompleteness of the information provided in the delivery records in the delivery rooms. As a result, the choice of records for mother-child pairs was guided by the completion of reporting tools.

4. Results

We calculated the sample size a posteriori on Statcal, to see how many cases and controls we needed in this study. For 95% confidence, 80% power, and a case/control ratio of 1, we took the prevalence of LBW from routine data from the Bounkiling health district in 2019, i.e. 7.35%. We also considered an OR of 2.89 which appreciated the most convincing risk of LBW in our study (history of low birth weight) after bivariate analysis.

The result of the calculation gives us 140 cases matched to 140 controls. This confirms the size of our study population, which was 237 cases for 237 controls.

4.1. Descriptive Study

4.1.1. Birth Weight

In our sample, the average weight of newborns was 2581.1 (±561.1) grams, with a minimum of 1000 grams and a maximum of 3980 grams. The median weight was 2497.5 grams, and the most frequent was 2400 grams.

In the group of newborns weighing less than 2500 grams, 97.05% had a low birth weight between 1500 grams and 2499 grams, and 2.95% had very low birth weight between 1000 grams and 1499 grams.

4.1.2. Distribution of Newborns by Sex and Clinical Status

Table 1 shows the distribution of neonates by sex, Apgar score at birth and presence of congenital malformations.

In our study, the sex ratio of births was 0.87 in favor of girls. The Apgar score at birth was not good (below 7) in 31.43% of newborns. The congenital malformations were found in 1.27% of births, mainly polydactyly and microcephaly.

Table 1. *Distribution of newborns by sex, Apgar score and presence of congenital malformations (n=474).*

Variables	Absolute frequency	Relative frequency (%)	CI 95%
Sex			
Female	253	53,38	48,8 – 57,82
Male	221	46,62	42,18 – 51,12
Apgar score			
Score < 7	149	31,43	27,42 – 35,75
Score ≥ 7	325	68,57	64,25 – 72,58
Malformation			72,58
Absent	468	98,73	97,27 – 99,42
Present	6	1,27	0,58 – 2,73

4.1.3. Distribution of Surveyed Mothers by Socio-Demographic Characteristics in the Bounkiling Health District in 2020

Table 2 summarizes the socio-demographic characteristics of the mothers surveyed during our study.

Table 2. *Distribution of surveyed mothers by socio-demographic characteristics.*

Variables	Absolute frequency	Relative frequency (%)	IC à95%
Place of residence			
Rural	338	71.31	67.08 – 75.20
Urban	136	28.69	24.80 – 32.92
Level education			
No schooling	338	71.31	67.08 – 75.20
Primary	96	20.25	16.88 – 24.10
Secondary	24	5.06	3.43 – 7.42
Koranic school	12	2.53	1.45 – 4.37
Literate	4	0.85	0.33 – 2.15
Ethnic group			
Peulh	198	41.77	37.42 – 46.26
Soc é	138	29.11	25.21 – 33.36

Variables	Absolute frequency	Relative frequency (%)	IC à 95%
Wolof	71	14.99	12.05 – 18.47
Diola	40	8.44	6.26 – 11.29
Sérère	15	3.16	1.93 – 05.16
Others	12	2.53	1.45 – 04.37
Occupation			
No profession	458	96.62	94.59 – 97.91
Self-employed	14	2.96	1.77 – 4.90
Employed	2	0.42	0.12 – 1.53
Monthly household income			
Less than 50,000	302	63.71	59.29 – 67.92
More than 50000	172	36.29	32.08 – 40.71
Marital status			
Married	452	95.36	93.07 – 96.92
Single	20	4.22	2.75 – 6.43
Divorced	2	0.42	0.12 – 1.53

1) Mother's age

A total of 474 women participated in this study. The mean maternal age was approximately 25.6 (±6.2) years, with a minimum of 14 years and a maximum of 46 years. The median age and mode were 25 and 20 years respectively.

The majority of women (81.2%) were adults aged between 20 and 39. Adolescent mothers (14-19 years) accounted for 17.08%, while women aged 40 or over made up 1.05% of our study.

2) Mother's height

The average height of the mothers was 161.3 (±5.8) centimeters, with extremes of 145 centimeters for the minimum and 189 centimeters for the maximum. The median was 161 centimeters and the mode 160 centimeters.

3) Women's level of education

71.34% of the women surveyed had no schooling; on the other hand, 20.25% had attended elementary school and 5.06% had reached at least secondary level. No women had higher education. 2.53% of mothers surveyed had attended a Koranic school.

4) Mothers' professional occupations

Most of the women surveyed had no professional occupation (96.62%), while 2.95% were self-employed and 0.42% had a salaried job.

5) Monthly household income

63.71% of women surveyed lived in households with a monthly income of less than 50,000 CFA francs.

6) Ethnicity of women surveyed

In our sample, the Peulh ethnic group was in the majority at 41.77%, followed by the Soc éat 29.11%, the Wolof at 14.98%, the Diolas at 8.44% and the Serer at 3.16%. Other ethnic groups represented 2.53% of the women surveyed (Bambara, Mancagne, Ba ñouk, Manjaque, Laob é, Diakhank é).

7) Marital status and the notion of consanguineous union.

The majority of women in the study were married (95.36%). The remainder were single mothers (4.22%) and divorced women (0.42%).

The notion of consanguineous union was found in 44.51% (95% CI [40.10 - 49.02]) of the women in our study.

4.1.4. Description of Maternal History and Pathologies During Pregnancy

Paucigravida women (2 to 3 pregnancies) accounted for 30.80% and first-time mothers for 24.47% of the women surveyed. Pauciparous women (2 to 3 births) accounted for 31.43%, and first-time mothers for 25.11%. 35.35% of women had attended at least four prenatal consultations during their pregnancy. However, 7.17% had attended only one prenatal visit at most. A history of abortion and stillbirth was noted in 10.55% and 3.16% of surveyed mothers respectively. The delivery of a low-birth-weight baby was noted in the obstetrical history of 5.91% of the women surveyed.

Maternal pathologies found during the study were essentially arterial hypertension (3.38%), malnutrition (2.53%) and anemia (0.84%).

4.1.5. Distribution of Mothers According to Lifestyle Habits

In our sample, the notion of physical work was found in

52.11% of the women surveyed. Intravaginal smoking was observed in 8.65% of mothers. Geophagy was found in 3.80% during pregnancy. We found no evidence of alcohol consumption or tobacco smoking.

4.2. Summary of Bivariate Analysis Results

Our study showed that there was a statistically significant association ($p< 0.05$) between the birth of a low-birth-weight newborn and the presence of certain characteristics linked to the mother's medical history, socio-demographic, socio-economic and pathological features.

Table 3 summarizes the risk factors identified in the occurrence of low birth weight among women in the Kolda health district after bivariate analysis.

Table 3. *Risk factors associated with low birth weight in the Bounkiling health district in 2020.*

Factors associated with Low Birth Weight	P value	OR IC à95%
Female sex	0,013	1,53 [1,06 –2,20]
Apgar Score < 7	0,0007	1,92 [1,29 – 2,85]
Age under 19	0,007	1,89 [1,15 – 3,09]
Monthly household income less than 50000	0,01	1,55 [1,06 – 2,26]
Mother's height less than or equal to 150 cm	0,01	4,16 [1,15 – 14,93]
Hard work during pregnancy	0,002	1,69 [1,17 – 2,43]
Number of prenatal consultations ≤ 2	0,002	1,82 [1,20 – 2,75]
Delivery history of LBW	0,00005	2,89 [1,67 – 4,97]
Maternal malnutrition	0,007	3,58 [1,30 – 9,88]
History of arterial hypertension	0,009	4,52 [1,27 – 16,09]

In the bivariate analysis, the risk of giving birth to a low-birth-weight baby was significantly increased in mothers aged 19 and under (OR=1.89 with 95% CI = 1.15 - 3.09), of height equal to or less than 150 cm (OR = 4.16 with 95% CI = 1.15 - 14.93), with a monthly income of less than 50,000, (OR=1.55 with 95% CI = 1.06 - 2.26).

It was also high among women with two or fewer prenatal visits (OR=1.82with 95% CI = 1.20 - 2.75) with obstetric histories of low birth weight (OR=2.89 with 95% CI = 1.67 - 4, 97), high blood pressure during pregnancy (OR=4.52 with 95% CI = 1.27 - 16.09), malnutrition (OR = 3.58with 95% CI = 1.30 - 9.88) and doing heavy work during pregnancy (OR = 1.69with 95% CI= 1,17 - 2,43).

These variables will be examined in the multivariate analysis to control for possible confounding factors. However, our work showed no statistically significant association with women's use of intra-vaginal smoking (p = 0.25), history of abortion (p = 0.22) or congenital malformations (p = 0.10). Those variables with a p-value less than or equal to 0.25 will be included in the multivariate analysis model.

4.3. Multivariate Analysis

Table 4 shows the factors associated with low birth weight in the multivariate analysis, with adjusted ORs, 95% confidence intervals and p-values.

After multivariate analysis, the factors independently and significantly associated were maternal age below 19 years (AOR=2.42 with CI = 1.43- 4.12); p = 0.001, household income below 50,000 CFA francs, (AOR=1.97 with CI=1.27-3.04); p = 0.002, maternal history of low birth weight (AOR=3.62 with CI=2.02-6.50); p = 0.000001, physical labor during pregnancy (AOR=1.80 with CI=1.20 - 2.69); p = 0.004, female sex of newborn (AOR=1.59 with CI=1.07 - 2.35); p = 0.019, Apgar score at birth (AOR=2.79 with CI=1.77 - 4.41); p = 0.000001.

Table 4. Factors associated with adjusted low birth weight infants.

Factors associated with low birth weight	Multivariate analysis	
	AOR IC 95%	p
Female sex	1,59 [1,07 – 2,35]	0,019*
Apgar Score < 7	2,79 [1,77 – 4,41	0,000001*
Age under 19	2,42 [1,43- 4,12]	0,001*
Monthly household income less than 50000	1,97 [1,27-3,04]	0,002*
Mother's height less than or equal to 150 cm	3,12	0,12
Hard work during pregnancy	1,80 [1,20 – 2,69]	0,004*
Number of prenatal consultations ≤ 2	1,42	0,08
Delivery history of LBW	3,62 [2,02-6,50	0,000001*
Maternal malnutrition	2,83	0,06
History of arterial hypertension	2,95	0,11
Intravaginal smoking	0,67	0,28
History of abortion	1,26	0,48
Congenital malformations	2,28	0,49

*Statistiquement significatif

5. Discussion

5.1. Characteristics of Low-Birth-Weight Newborns

In our study, the categorization of low-birth-weight newborns shows that the majority (97.05%) had a weight between 1500 and 2499 grams. This same trend was observed in other studies carried out in the Guédiawaye and Kolda health districts in Senegal [10-15] and in Tunisia [16].

In relation to the sex of the newborns, our results showed that there was a statistically significant association between the delivery of a female child and low birth weight (p = 0.019). This result is in line with that of studies carried out in the Democratic Republic of Congo [17], Tunisia [18] and Brazzaville [19]. However, other studies have not found this relationship [20, 21].

The results of our work also show that low-birthweight infants are about five times more likely to have an Apgar score of less than 7, which reflects a poor neurological state of the newborn, than normal-weight infants. This relationship was statistically significant in our study. The same conclusion was reached in studies carried out in Cameroon, Algeria, Tunisia and Madagascar [16-24]. However, in Kolda, Mangane [15] did not find a significant link, but agreed with our finding that LBWs are more likely to have an Apgar score of less than 7.

5.2. Maternal Characteristics and Risk Factors

The socio-demographic characteristics of the mothers show that most (81.2%) were aged between 20 and 39. The majority (71.31%) lived in rural areas. However, in our study, we did not find a significant association between the mother's place of residence and the birth of a low-weight newborn. This result was observed in studies carried out in Lubumbashi in the Democratic Republic of Congo [21], and in Senegal in the regions of Thiès [25] and Kolda [15].

Four groups of maternal risk factors associated with low birthweight were identified in the context of the Bounkiling health district.

1) Maternal age

A statistically significant association between young maternal age and the delivery of a low-birth-weight newborn was found. Mothers under 19 years of age were 2.42 times more likely to deliver a low-birth-weight baby (p =0.001). In Senegal, studies have shown that the risk of a woman giving birth to a low-birth-weight baby was real in the adolescent group [15-26]. Similar results were found by others in studies carried out in Canada [27], the Democratic Republic of Congo [17], Mali [28] and Cameroon [22]. However, other studies had not found this link [29, 30, 31]. The link found in our study may be explained by the fact that teenage pregnancy remains a public health issue for the young mother and her newborn, as it is an obstetric situation that presents risks that may be underestimated. In

literature, it is frequently mentioned that follow-up of adolescents is inadequate and delayed during pregnancy [32]. Adolescent girls have not yet completed their growth and are more likely to give birth to low-birth-weight babies than adult mothers with the same nutritional status [17]. In our context, the southern regions, where the Bounkiling department is located, are marked by an early childbearing age among 15–19-year-olds: 26.0% compared with 7.1% for the western regions, 16.2% for the northern regions and 19.5% for the central regions [33]. This situation could explain the high prevalence of low birth weight.

2) Low monthly income

Our work has shown that mothers living in families with a monthly income of less than 50,000 CFA francs were 1.97 times more likely to give birth to a low-birth-weight baby (P=0,002).). This significant difference was found in Senegal by studies carried out in Guédiawaye [34] and by Mangane [15]. Another study in Morocco showed that there was no statistically significant link between the birth of a low-weight newborn and low family income among women [20]. These results from Bounkiling can be explained by the fact that the Sédhiou region is one of the poorest in the country. This poverty has repercussions on household income and therefore on the provision of basic needs, particularly for pregnant women, but also for children. The EDS-continue 2017, shows that it is in the lowest quintile of economic well-being that we note the highest percentage of births weighing less than 2500 grams (15% versus 11%) [35].

3) Obstetrical history of low birth weight

Our study showed that the prevalence of low birth weight was 3.62 times higher in women with an obstetrical history of LBW than in those who had given birth to normal-weight children in their previous pregnancy with p=0,000001. Similar results have been found in studies carried out in Senegal in the health districts of Guédiawaye and Kolda, as well as in Morocco, where there was a statistically significant association between the delivery of a low-weight child and an obstetrical history of low birth weight [15-34, 36]. The existence of this non-modifiable risk factor could reflect the presence of maternal health problems that are insufficiently managed during pregnancy [15]. Contrary to these findings, a study carried out in the Democratic Republic of Congo [21] did not establish a statistically significant relationship between the birth of a low-birth-weight baby and the mother's obstetric history of LBW.

4) Physical work during pregnancy

Our research showed that mothers who engaged in physical labor during pregnancy were 1.80 times more likely to give birth to a low-birth-weight baby than those who did not. A statistically significant relationship was found (p = 0.004). Similar results were found in studies carried out in the Guédiawaye health district in Senegal and in Kolda, Morocco, where there was a statistically significant association between low-birth-weight babies and physical labour during pregnancy [34-37]. Contrary to these results, Magane [15] and Ferraz in Brazil [38] did not establish a statistically significant relationship between the birth of a low-weight child and physical labour during pregnancy. In our context, these results could be explained by the situation of household poverty, which forces women to carry out arduous daily tasks such as field work and trading over long distances. The absence of running water means that women are also forced to draw water from wells for domestic chores. These difficult living conditions could lead to the early onset of labor, resulting in premature, low-birth-weight babies. However, in Kolda, Mangane [15] did not find a significant link, but agreed with us that LBWs are more likely to have an Apgar score below 7.

5) Other risk factors reported in the literature.

a) Maternal height: the results of our study do not show a statistically significant association between the mother's height and the delivery of a low-birth-weight baby. This association has also not been demonstrated in studies carried out in Senegal, notably in Kolda [15]. Contrary to our results, other studies have shown a significant link between mothers of less than 150 centimeters in height and the occurrence of low birth weight [39].

b) Primiparity and primigravidity: the results of our study do not show a statistically significant association between these two factors and the delivery of a low-birth-weight infant. This association was not found in studies carried out in Thiès, Kolda and the Democratic Republic of Congo [15-25, 17]. Contrary to our results, other studies have shown a significant association between primigravida and primiparous mothers and the occurrence of low birth weight [23-34].

Insufficient prenatal consultations: in our study, women who underwent no more than 2 prenatal consultations during pregnancy were almost 1.42 times more likely to deliver a low-birth-weight baby than those who underwent more than 2 prenatal consultations. However, a statistically significant association was not found (p = 0.08). These results were corroborated by those obtained by Mangane [15], Hassoun et al [20], and Kabore et al [37]. On the other hand, Camara et all in Senegal [34], Chiabi et all [22] in Cameroon, as well as numerous other studies [40-42] had found a significant link between insufficient prenatal consultations and low birth-weight delivery. The results in our study could be explained by the fact that any contact between the health care system and the pregnant woman is an opportunity to carry out a complete examination and analysis, in order to detect and manage any abnormalities. to detect and manage possible pathologies and risks of LBW or pregnancy complications.

Tobacco consumption: the link between tobacco consumption during pregnancy and the occurrence of low birth weight was not established in our study. Studies carried out in Thiès and Kolda in Senegal [15-25] and in Congo [17] also failed to show this relationship. This finding may be explained by the low prevalence of smoking among women, which stands at 0.4% in Senegal [33]. However, in the literature, maternal cigarette consumption in the third trimester

was the strongest predictor of birth weight per centile ($P < 0.001$). For each additional cigarette per day a participant smoked during the third trimester, there was an estimated 27 g reduction in birth weight. [42]

a) Hypertension: the link between hypertension during pregnancy and low birth weight was not established in our study. However, this association was found in several studies carried out in Senegal [15-43] the Republic of Guinea [39], the Democratic Republic of Congo [21] and Morocco [36]. The mechanism involved in the delivery of low-birth-weight infants is thought to be related to abnormalities in placentation with reduced uteroplacental perfusion, with consequent repercussions on fetal development [25].

b) Diabetes: the link between diabetes during pregnancy and low birth weight has not been established in our study. However, this association was found in a Chinese analysis of data from two large prospective cohort studies, presented in the Journal of Diabetes. [44].

6. Conclusions

The results of our study in the Bounkiling health district highlighted the link between the delivery of a low-birth-weight baby and six risk factors: female sex of the newborn, Apgar score below 7, young age of the mother (under 19), household income below 50,000 CFA francs, obstetrical history of low birth weight and physical labor during pregnancy. Intensifying the implementation of strategies to improve adolescent reproductive health, strengthening communication with adolescents and community leaders on the issue of early marriage and pregnancy, raising the socio-economic level of women through their empowerment, and improving pregnancy monitoring at health facilities are all levers that could be used to combat the risk factors of low birth weight and thus improve neonatal and infant/child health in the Bounkiling health district.

Abbreviations

AMREF: African Medical and Research Fundation
AOR: Ajusted Odds Ratio
CI: Confidence Interval
DHS: Demographic and Health Survey
HIV: Human Immunodeficiency Virus
LBW: Low Birth Weight
MSI: Marie Stopes International
OR: Odds Ratio
TFR: Total Fertility Rate
UNFPA: United Nations Population Fund
UNICEF: United Nations Children's Fund
USAID: United States Agency for International Development
WHO: World Health Organization

Acknowledgments

Special thanks to:
1) The patients who agreed to participate in the study
2) The medical team of the Bounkiling health center
3) Institut de Santé et Développement.

Conflicts of Interest

The authors declare no conflicts of interest.

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