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Original Research Article

Determinants of birth weight abnormalities at a university hospital in Mahajanga, Madagascar: a prospective case-control study

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ABSTRACT

Background: Birth weight abnormalities, including low birth weight and macrosomia, represent a major public health problem due to their neonatal and long-term consequences. Identifying the associated factors helps guide prevention strategies adapted to the local context of the neonatology department of the University Hospital Center of Mahajanga, Madagascar.

Methods: This was a prospective descriptive and analytical case-control study conducted from 19 March to 19 September 2024, in the neonatology department of the University Hospital Center of Mahajanga, Madagascar. Seventy-four newborns presenting with birth weight abnormalities were compared with 222 controls with normal birth weight. Sociodemographic, obstetric, and maternal factors were analyzed.

Results: The hospital incidence of birth weight abnormalities was 9%. The identified risk factors were gestational hypertension (OR=9.84; 95% CI: 4.21–21.02), fewer than four antenatal care visits (OR=4.73; 95% CI: 2.01–10.12) and single marital status (OR=2.79; 95% CI: 0.98–7.99). Conversely, maternal age between 18 and 35 years (OR=0.42; 95% CI: 0.21–0.84), iron and folic acid supplementation (OR=0.34; 95% CI: 0.16–0.72), normal maternal body mass index (OR=0.51; 95% CI: 0.27–0.95) and secondary or higher education level also reduced the risk (OR=0.31; 95% CI: 0.15–0.66) had a protective effect.

Conclusion: Birth weight abnormalities at the University Hospital of Mahajanga are mainly influenced by modifiable maternal determinants. Strengthening antenatal care and early management of hypertensive disorders could significantly reduce their frequency.

Keywords: Birth weight, Low birth weight, Macrosomia, Antenatal care, Maternal determinants, Madagascar

INTRODUCTION

Birth weight is a key indicator of neonatal health and an important predictor of child survival and long-term health outcomes. According to the World Health Organization, approximately 15% of births worldwide are affected by low birth weight, with a markedly higher prevalence in low- and middle-income countries.[1] In sub-Saharan Africa, the prevalence of low birth weight generally ranges between 13% and 20%, reflecting the influence of maternal nutrition, infectious diseases, and socioeconomic conditions on fetal growth.[2]

Infants with low birth weight have a neonatal mortality risk estimated to be 5 to 20 times higher than that of infants with normal birth weight, mainly due to prematurity, neonatal infections, and respiratory distress.[3]

Conversely, fetal macrosomia, although less frequent, is associated with obstetric complications such as shoulder dystocia, birth trauma, and perinatal asphyxia, which may increase perinatal morbidity and mortality.[4] The prevalence of macrosomia is estimated to range from 3% to 10% of births worldwide, with an increasing trend in many developing countries due to urbanization, changes in dietary patterns, and the growing prevalence of gestational diabetes.[5]

In Madagascar, low birth weight remains a significant public health concern. Data from Demographic and Health Surveys estimate its prevalence between 12% and 16%, with regional disparities influenced by maternal nutritional status and access to antenatal care services.[6] Furthermore, birth weight abnormalities contribute substantially to neonatal mortality in the country, where the neonatal mortality rate remains high, estimated at approximately 19 deaths per 1,000 live births.[7]

Despite the importance of this issue, analytical data identifying the determinants of birth weight abnormalities remain limited in Madagascar, particularly in the Mahajanga region. Identifying the factors associated with these abnormalities could help guide targeted preventive strategies and improve maternal and neonatal health outcomes in this setting. Therefore, the aim of this study was to identify the determinants associated with birth weight abnormalities at the University Hospital Center of Mahajanga, Madagascar.

METHODS

This was a prospective analytical case-control study conducted over a six-month period from 19 March to 19 September 2024, at the Mother and Child Complex of the University Hospital of Mahajanga.

The minimum sample size was estimated based on an expected prevalence of low birth weight of 15%, with a 5% alpha risk and 80% statistical power. The required sample size was 70 cases and 210 controls. The study included 74 cases and 222 controls.

Cases included live newborns with birth weight <2500 g or ≥4000 g. Controls were newborns with normal birth weight. Multiple pregnancies, major congenital malformations, and incomplete medical records were excluded.

Gestational hypertension was defined according to the criteria of the American College of Obstetricians and Gynecologists. Adequate gestational weight gain was defined according to the recommendations of the Institute of Medicine.

Data were analyzed using statistical package for the social sciences (SPSS) software version 13.0. Comparisons were performed using the Chi-square test or Fisher's exact test. Multivariate logistic regression was conducted to identify independent factors. Written informed consent was obtained from the mothers. The principles of the Declaration of Helsinki were respected.

RESULTS

Figure 1 shows the recruitment of patients.

The hospital prevalence of weight abnormalities was 49% (Figure 1).

The 222 newborns with normal birth weight constituted the control group, according to the 1/3 ratio defined in the methodology.

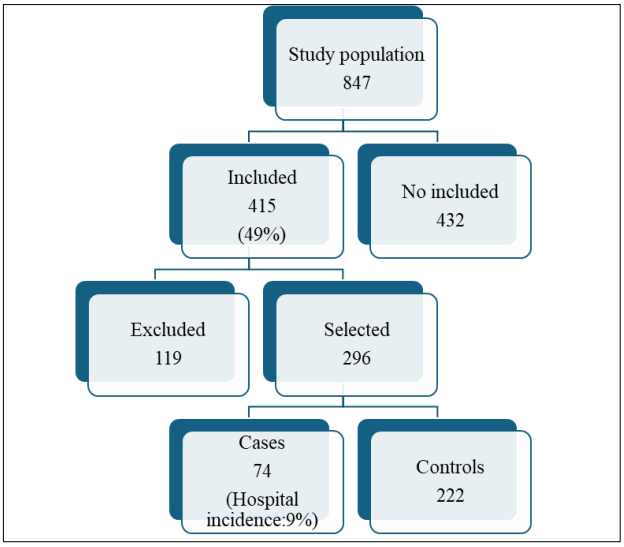

Figure 1: Recruitment flow diagram.

The sex ratio was 1.21.

Table 1 shows the distribution of newborns by birth weight.

Table 1: Distribution of newborns according to birthweight.

Birth weight	Frequency (n=296)	Percentage (%)
Less than 2500 g	39	13.2
Between 2501 g and 3499 g	222	75.0
Greater than or equal to 3500 g	35	11.8

The mean birth weight of the newborns was 3007 g, with values ranging from 1752 g to 4246 g.

Table 2 shows the association between significant factors and birth weight abnormalities.

There was a significant association between the occurrence of weight abnormalities and the following

factors: maternal age, maternal BMI, iron and folic acid supplementation during pregnancy, maternal education level, marital status, and the presence of hypertension during pregnancy (p<0.005). The identified risk factors were maternal hypertension during pregnancy, fewer than four antenatal visits, and single marital status. Protective factors included maternal age between 18 and 35 years, normal maternal BMI, iron and folic acid supplementation, and an education level higher than secondary school (Table 2).

Table 2: Association between significant parameters and birth weight abnormalities.

Variables	Case, n=74, N (%)	Control, n=222, N (%)	P value	OR	CI in 95%
Maternal age (years)					
18 to 34	51 (68.9)	182 (82.0)	0.017	0.49	[0.27-0.89]
<18 and ≥35	23 (31.1)	40 (18.0)			
Maternal BMI					
BMI normal	31 (41.9)	134 (60.9)	0.006	5.21	[0.28-0.81]
BMI abnormal	43 (58.1)	88 (39.6)			
Iron/folic acid					
Yes	68 (91.9)	218 (98.2)	0.009	0.21	[0.06-0.76]
No	6 (8.1)	4 (1.8)			
Education level					
≥Secondary	60 (81.1)	206 (92.8)	0.04	0.33	[0.15-0.72]
Others	14 (18.9)	16 (7.2)			
Antenatal care visits					
<4	17 (23.0)	12 (5.4)	0.000	5.21	[2.35-11.5]
≥4	57 (77.7)	210 (94.6)			
Marital status					
Single	67 (90.5)	214 (96.4)	0.047	2.79	[0.98-7.99]
In a relationship	7 (9.5)	8 (3.6)			
Hypertension					
Yes	26 (35.1)	11 (5.0)	0.000	10.39	[4.80-22.47]
No	48 (64.9)	211 (95.0)			

DISCUSSION

This study highlights a hospital incidence of 9% of birth weight abnormalities at the University Hospital of Mahajanga. This rate is lower than global estimates of low birth weight, which are around 15% according to the World Health Organization.[1,2] This difference may be explained by the hospital-based nature of the study and possible underrepresentation of rural deliveries.

Gestational hypertension was the most strongly associated determinant in our study. Maternal hypertensive disorders are known to impair uteroplacental perfusion, leading to intrauterine growth restriction.[8] Several meta-analyses confirm the association between gestational hypertension and low birth weight.[9] Our findings are therefore consistent with international data.

Insufficient antenatal care also represents a major risk factor. The World Health Organization recommends a minimum number of antenatal visits to improve maternal and neonatal outcomes.[10] Inadequate follow-up limits early detection of maternal conditions such as hypertension or anemia, which may compromise fetal growth.

Iron and folic acid supplementation appears to be an independent protective factor. Iron deficiency during pregnancy is associated with an increased risk of low birth weight.[11] Systematic supplementation programs have demonstrated their effectiveness in reducing neonatal complications, particularly in low-resource settings.[12]

Normal maternal body mass index was also a protective factor. The literature shows that maternal undernutrition and, conversely, obesity are associated with abnormalities of fetal growth.[13] The Institute of Medicine emphasizes the importance of adequate gestational weight gain according to initial BMI to reduce the risk of low birth weight or macrosomia.[14]

Socioeconomic factors, particularly educational level, play an indirect role through access to care and adherence to medical recommendations. Studies conducted in similar contexts have shown that low maternal education level is associated with an increased risk of low birth weight.[15]

Limitations

As a single-center study, the findings may not be fully generalizable and may underestimate normal births occurring in peripheral settings.

CONCLUSION

Birth weight abnormalities at the University Hospital of Mahajanga remain a significant public health concern, with a hospital incidence of 9%. This study highlights the major role of modifiable maternal factors, particularly gestational hypertension and inadequate antenatal care, in the occurrence of these abnormalities. Conversely, adequate antenatal follow-up, iron and folic acid supplementation, normal maternal nutritional status, and higher educational level appear to have a protective effect.

These findings emphasize the need to strengthen antenatal care services, promote maternal education, and improve early screening and management of hypertensive disorders during pregnancy. Targeted interventions focusing on these determinants could contribute to reducing the burden of birth weight abnormalities and improving neonatal outcomes in Madagascar.

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