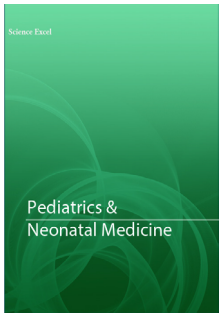
Pediatrics and Neonatal Medicine

Original Article



Fetal Macrosomia And Associated Factors at The National Hospital Center of Pikine (CHNP) Dakar/ Senegal

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Abstract

Introduction: Fetal macrosomia is a major risk factor for perinatal and maternal morbidity and mortality in developing countries such as Senegal. With this in mind, the objectives of our study were to describe the epidemiological, clinical, paraclinical and evolutionary characteristics of macrosomic newborns admitted to the Pikine National Hospital Center and to study the factors associated with macrosomia.

Materials and methods: This was a prospective study conducted over a period of 6 months, from 1 December 2021 to 30 June 2022 at the CHN of Pikine.

Results: The hospital prevalence was 4.79%. The most represented maternal age group was between 25 and 35 years. The medical-obstetric pathologies during pregnancy were dominated by gestational diabetes (46.1%). The average maternal body mass index (BMI) during pregnancy was 28.47 ± 4.7 kg/m². The majority of macrosomic babies were born at term. Macrosomia was Grade 1 in 75.65% of cases. The main complications were hypoglycaemia and obstetric trauma. Cardiac abnormalities were found in newborns of diabetic mothers. Mortality was 2.61%. Factors that were significantly associated with macrosomia were: multiple gestations, multiple pregnancies and a history of macrosomia.

Conclusion and recommendations: Even if its incidence seems low compared to LBW, fetal macrosomia can lead to obstetrical and neonatal complications that can be dramatic for the mother and/or the newborn; hence the need to ensure their prevention through better monitoring of pregnancy and delivery in all pregnant women at risk.

Keywords
child; genetic; malnutrition; MT-CYB; mutation

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Introduction

Macrosomia refers to excessive intrauterine growth above a specific threshold, regardless of gestational age. Depending on the country, studies report different thresholds, notably a birth weight greater than 4000 g or 4500 g or greater than the 90ème, 95ème or 97ème percentile [1-3].

It is a public health problem in developing countries, as it contributes to an increase in perinatal morbidity and mortality through the risk of traumatic or metabolic complications in the fetus and obstetric complications in the mother. This risk of complications increases with the degree of macrosomia [1]. Due to advances in perinatal care, the management and outcome of macrosomic newborns has improved considerably in developed countries compared to resource-poor countries [4-6]. The prevalence of newborns with a birth weight of more than 4000 g is about 9% worldwide and about 0.1% for those with a birth weight of more than 5000 g, with large variations between countries [4]. In low-income countries, it is estimated at 1-5% but varies from 0.5-14.9% [5]. In Africa, neonatal mortality remains very high and of concern, particularly in Senegal (21 ‰ live births) where scientific data on macrosomia are quite limited [6]. The national prevalence of macrosomia was estimated at 3.11% in 2013 [7]. Therefore, planning an appropriate intervention requires knowledge of the magnitude and factors associated with macrosomia.

It is in this perspective that this study carried out in Senegal has set itself the main objective of assessing macrosomia at the CHN of Pikine located in the suburbs of Dakar in Senegal.)

The specific objectives were to

- To describe the epidemiological, clinical, paraclinical and evolutionary characteristics of macrosomic newborns.
- To study the factors associated with macrosomia.

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Materials and methods

Study framework

The study took place in the paediatric department of the Center Hospitalier National of Pikine (CHNP), a level 3 public health establishment resulting from cooperation between the Kingdom of Spain and the Republic of Senegal. It officially started its activities on 26 December 2006. The paediatric service includes a paediatric emergency unit with a capacity of 4 cradles, an incubator and 1 bed, 3 neonatology units, one of which is located in the maternity ward and has a capacity of 8 cradles for newborns, a unit for premature babies with a capacity of 8 incubators, and another unit in the paediatric ward for newborns with 8 cradles and 2 incubators.

The medical staff consists of 2 university hospital paediatricians, 3 hospital paediatricians, doctors specialising in paediatrics and students from 5ème and 7ème years of medicine. The paramedical staff consists of 30 nurses and care assistants.

The gynaecology-obstetrics department is divided into two sectors: the in-patient department near the paediatrics department; and the delivery room with a capacity of 9 beds located near one of the maternity hospital's neonatology units (directly admitting inborn babies), the operating theatre and the intensive care unit. The staff is composed of 3 university hospital gynaecologists, 2 hospital gynaecologists, doctors in specialisation and 23 midwives and 5 nurses.

Type of study

This is a prospective, descriptive and analytical study conducted in the paediatric department of the CHNP over a period of 6 months, from 1er December 2021 to 30 June 2022.

Study population

We included all newborns aged zero (0) to 28 days, with a birth weight greater than or equal to the 90ème percentile, admitted to the NPHC during the study period. All babies with a birth weight below the 90ème percentile were excluded.

Data collection

The data were collected on a pre-established survey form after consultation of the hospitalization records, the health record and the liaison form for referred newborns. For each file, the parameters collected were the following:

- Maternal epidemiological and socio-demographic data: age, geographical area of origin, marital status, occupation, level of education, socio-economic level, family condition;
- Maternal medical and gynaeco-obstetrical data: gesity, parity, medical and gynaeco-obstetrical history, pregnancy follow-up, medical and obstetrical pathologies during pregnancy, evolution of pregnancy and delivery, mode of delivery, type of presentation, place of delivery;
- Neonatal data: cry at birth, notion of resuscitation, Apgar score, age at admission, gestational age, sex, origin, birth weight, reasons for admission, selected diagnosis,
- Therapeutic data: treatment administered
- The evolutionary modalities: length of hospitalization, occurrence of complications, mortality.

Data capture and analysis

Data entry and analysis was done with R software version 4.1.1. Continuous variables were described as mean and standard deviation (m ± SD), while categorical variables were described as number and percentage (n, %). For statistical comparisons, we used Pearson's Chi2, Fisher's exact test, Student's t-test or Mann Whitney test, depending on the conditions of application. A value of $p < 0.05$ is defined as the significance level for all statistical tests.

Results

Epidemiological and socio-demographic data

Workforce

A total of 115 macrosomic infants were collected during the study period.

Frequency

The hospital incidence of macrosomic newborns was 4.79%.

Age of mothers

The mean maternal age was 29.6 ± 6.5 years with extremes ranging from 16 to 44 years. The median was 30 years. The most common maternal age range was 25 to 35 years (Figure 1).

Origin of the mothers

Almost all the mothers, 94.6%, came from the suburbs of Dakar.

Marital status of mothers

Almost all the mothers (97.4%) were married.

Profession of mothers

The majority of the mothers were housewives (58.4%) (Table I).

Educational level of mothers

More than half of the mothers (56.52%) were illiterate.

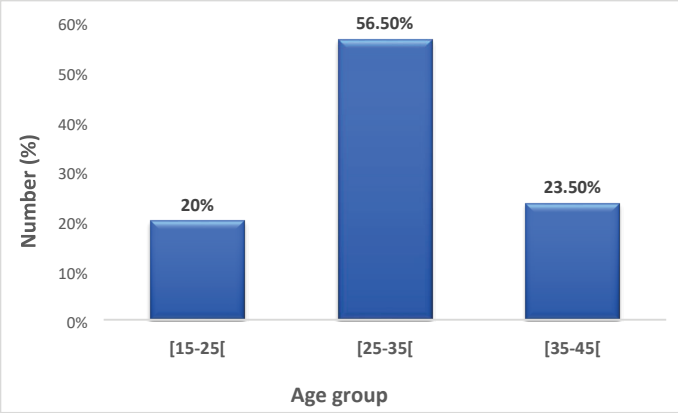

Figure 1. *Distribution of cases by maternal age group.*

Table 1. *Distribution of cases according to the socio-economic level of the mothers.*

Mothers' occupations	Number (N)	(%)
Housewife	66	58,4
Shopkeeper / Saleswoman	28	24
Civil servant	8	7,1
Other	13	10,5
TOTAL	115	100

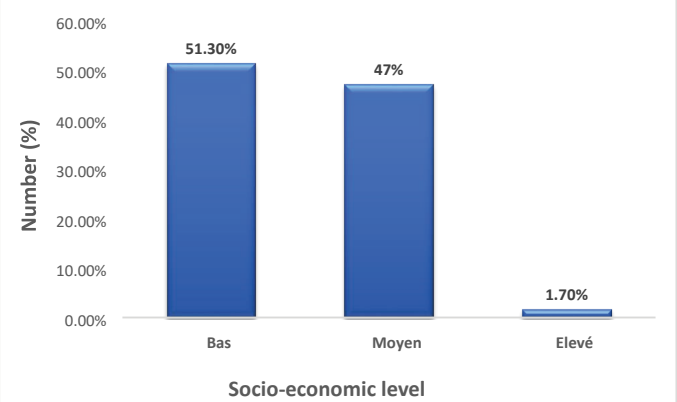

Figure 2. *Distribution of cases according to the socio-economic level of the mothers.*

Socio-economic level of mothers

Half of the mothers (51.3%) had a low socio-economic level, compared to 47% who had an average socio-economic level. (Figure 2).

Maternal medical and gynaecological-obstetric data

Medical history of mothers

A medical history was found in 3.48% of the mothers in the form of hypertension (1.74%) and type 2 diabetes (1.74%).

Maternal gender and parity

The average pregnancy of the mothers was 3 with extremes ranging from 1 to 10. The average parity was also 3 with extremes ranging from 1 to 9. Of the dams, 72% were pauciparous, 25% were multiparous and 3% were grand multiparous (Figure 3).

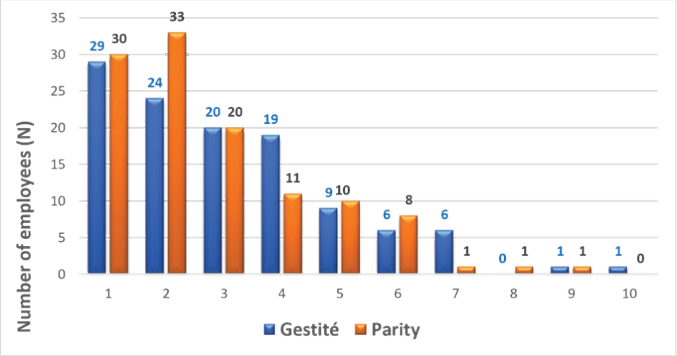

Figure 3. *Distribution of cases by gender and parity of mothers.*

Intergenerational interval of mothers

Almost all mothers (99.9%) had a normal intergenic interval.

Maternal history of fetal macrosomia

A history of delivery of a macrosomic infant was found in 38 mothers, i.e. a proportion of 33%.

History of neonatal deaths

Only 6.1% of mothers had a history of neonatal death.

Medical and gynaeco-obstetric pathologies

The majority of the mothers (63.49%) had presented with pathologies during pregnancy which were dominated by gestational diabetes (46.1%) and gestational hypertension (11.3%). Only 2 mothers had received oral glucose tolerance tests (OGTT). Glycated haemoglobin (HbA1C) was performed in only one (1) mother. Two (2) cases of unbalanced gestational diabetes in the hyperglycaemic and acidotic mode were noted. Insulin treatment was initiated in 3 cases (Table II).

Table II. *Distribution of cases according to the presence of medical and gynaecological-obstetric pathologies during pregnancy.*

Medical and gynaeco-obstetric pathologies during pregnancy	Workforce	(%)
Gestational diabetes	53	46,1
Pregnancy-induced hypertension	13	11,3
Anemia	1	0,87
Hydramnios	2	1,74
Retroplacental haematoma	3	2,61
Fibroma	1	0,87
Polycystic ovarian disease	1	0,87
Pre-eclampsia	6	5,22

Maternal weight gain during pregnancy

The average maternal weight was 88.5 kg with extremes ranging from 49 kg to 128 kg. The majority of the mothers (61.74%) had a weight gain of between 10 and 15 kg.

Eight point sixty percent (8.69%) of the mothers had a weight gain of more than 15 kg and 29.56% of the mothers less than 10 kg during the pregnancy (Figure 4).

Body mass index (BMI) of mothers during pregnancy

The mean maternal BMI during pregnancy was 28.47 ± 4.7 kg/m² with extremes ranging from 20 to 45.8 kg/m². The median was 28 kg/m² (Figure 5).

Number of antenatal visits (ANC) during pregnancy

The average number of ANC was 3.8 ± 1 with extremes ranging from 1 to 7. The majority of mothers, 79.1%, had performed 4 ANC during the pregnancy (Figure 6).

Number of ultrasound obstetric during pregnancy

All mothers had performed an obstetric ultrasound during the pregnancy, of which 9.13% had performed 3 ultrasounds, 21.74% had performed 2 ultrasounds and 59.13% had performed only one (1) ultrasound during the pregnancy.

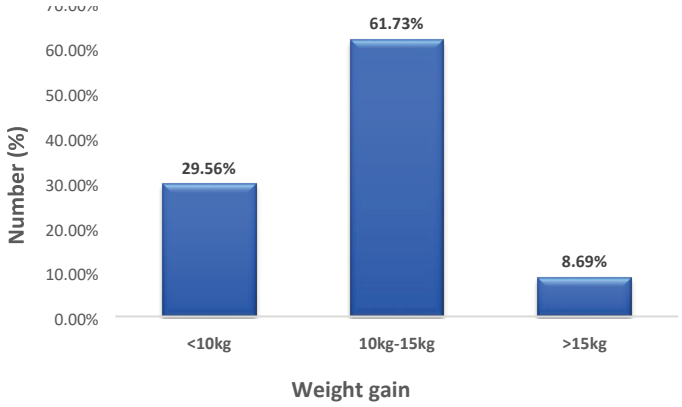

Figure 4. *Distribution of cases according to the socio-economic level of the mothers.*

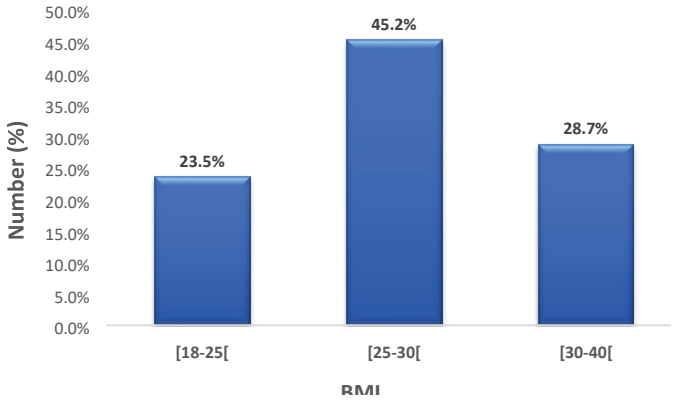

Figure 5. *Distribution of cases according to the socio-economic level of the mothers.*

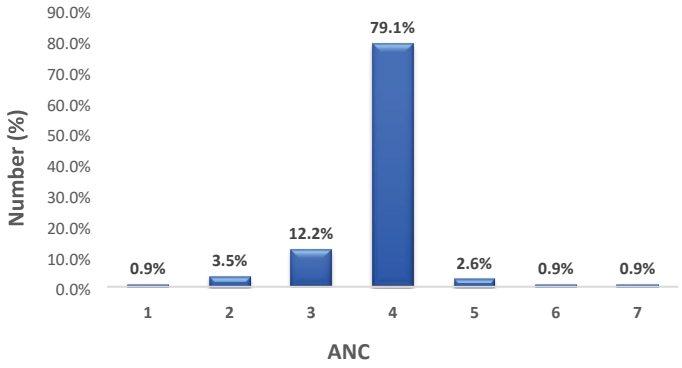

Figure 6. *Distribution of cases by number of ANCs.*

Delivery data

Term of pregnancy

The majority of macrosomic newborns, 90.44%, were born at term, compared with 9.56% of post-mature newborns. We did not note any prematurity.

Route of delivery and the concept of dystocia

Half of the mothers (53%) had given birth by caesarean section compared with 47% by vaginal delivery. Delivery was dystocic in 7.8% of cases, with recourse to instrumental manoeuvres.

Mode of presentation

The presentation was cephalic in almost all cases (98.3%) (Figure 7).

Place of delivery

All the mothers had given birth in a health facility, 98.26% (113 cases) in a level 3 hospital and 1.74% (2 cases) in a health district.

Birth data

Notion of crying at birth

Almost all macrosomic infants (93.9%) had cried at birth.

Notion of resuscitation at birth

Only 6 macrosomic infants (5.22%) were resuscitated at birth.

Apgar score at birth

The Apgar score was less than 7/10 at 5ème minutes in 4 macrosomes (3.5%) (Figure 8).

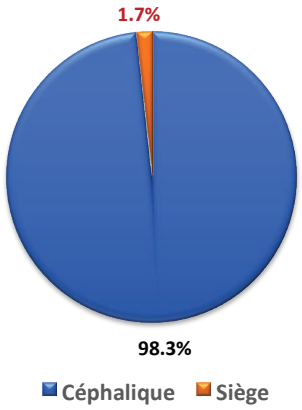

Figure 7. *Distribution of cases by mode of presentation.*

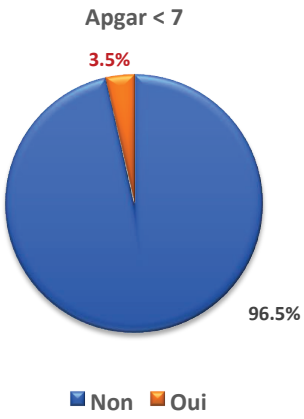

Figure 8. *Distribution of cases by Apgar score at 5 minutes*

Data neonatal

Age at admission

Almost all macrosomes (98.26%) were admitted within the first hour of life . Two (2) cases (1.74%) were admitted at D2 and D18 of life.

Gender

The sex ratio was 0.74 with a slight male predominance (Figure 9).

Place of birth

Almost all the newborns, 97.3%, were inborn, compared with 2.7% of macrosomic outborns.

Category of macrosomia

According to weight category, newborns had Grade 1 macrosomia (weight between 4000 g - 4499 g) in 75.65% of cases, Grade 2 macrosomia in 8.8% of cases (weight between 4500 g - 4999 g) and Grade 3 macrosomia in 0.9% of cases (weight over 5000 g) (Figure 10).

Clinical signs objectified at birth

Respiratory distress was found in 5 cases and neurological distress in 2 cases. Metabolic disorders such as hypoglycaemia and hypothermia were found in 24 cases (21.2%) and 3 cases (2.61%) respectively. Of the 115 macrosomes collected, 5 were hospitalised. The others were monitored in the delivery room before delivery.

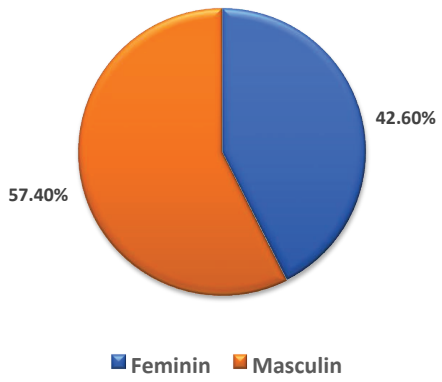

Figure 9. *Distribution of cases by gender*

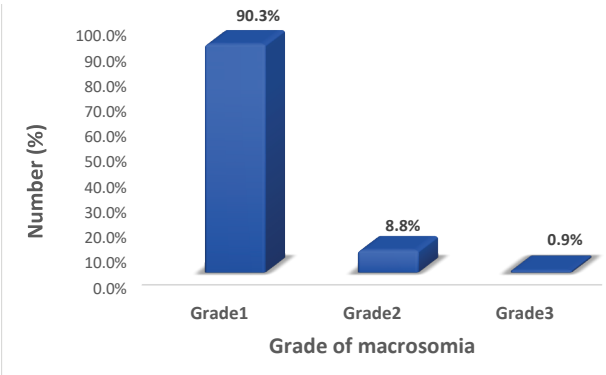

Figure 10. *Distribution of cases by category of macrosomia*

Clinical diagnosis

The clinical diagnoses selected were, in order of frequency, obstetric trauma (14%), followed by maternal-fetal infection (MFI) (4.39%) and perinatal asphyxia (3.48%) (Table III).

According to the type of obstetrical trauma, serosanguineous bump was found in 6 cases (37.50%), brachial plexus elongation and clavicle fracture in 5 cases (31.20%) respectively (Table IV).

Table III. *Distribution of cases according to clinical diagnosis.*

Selected clinical diagnosis	Number of employees	
	(N)	(%)
Obstetrical trauma	16	14
MFI	5	4,39
Perinatal asphyxia	4	3,78
Transient tachypnea in the newborn:	2	1,74
Inhalation of clear amniotic fluid	1	0,87
Hyaline membrane disease	1	0,87

Table IV. *Distribution of cases by type of obstetrical trauma.*

Type of obstetrical trauma	Number	%
Serosanguine hump	6	37,50
Fracture of the clavicle	5	31,20
Elongation of the brachial plexus	5	31,20

Paraclinical data

Hypoglycaemia was found in 24 cases (21.2%). There were no cases of hypocalcaemia and polycythemia. Echocardiography was performed in 12 newborns (10.43%). The anomalies found were septal hypertrophy (2 cases), atrial septal defect (1 case) and patent ductus arteriosus (1 case). All these cardiac anomalies were found in macrosomes of diabetic mothers.

Therapeutic data

All newborns received essential care at birth. Early feeding was de rigueur in 97.3% with milk 1er age or breast milk. Regarding ventilatory support, CPAP was indicated in 2 macrosomes. Only 4 newborns (3.5%) had continued antibiotic therapy. All newborns had received vitamin D supplementation.

Developmental data

Length of stay

The average length of stay of the 5 hospitalized macrosomes was 16 ± 7 days with extremes ranging from 1 to 37 days.

Mortality rate

The mortality of macrosomic newborns was 2.61% (3 cases) compared to 97.39% survival. The causes of death were related to Sarnat 3 anoxic-ischaemic encephalopathy on perinatal asphyxia.

Table V. *Socio-demographic, medical and maternal gynaeco-obstetrical characteristics associated with macrosomia.*

Variables	Macrosomia			p-value
	Grade 1	Grade 2	Grade 3	
Age group				0.899
[15-25]	22 (95.7%)	1 (4.35%)	0 (0.00%)	
[25-35]	56 (88.9%)	6 (9.52%)	1 (1.59%)	
[35-45]	24 (88.9%)	3 (11.1%)	0 (0.00%)	
BMI				0.262
[18-25]	25 (96.2%)	1 (3.85%)	0 (0.00%)	
[25-30]	46 (88.5%)	6 (11.5%)	0 (0.00%)	
[30-40]	29 (90.6%)	2 (6.25%)	1 (3.12%)	
>40	2 (66.7%)	1 (33.3%)	0 (0.00%)	
Gestité				0.015
[0-3]	66 (91.7%)	5 (6.94%)	1 (1.39%)	
[4-7]	36 (92.3%)	3 (7.69%)	0 (0.00%)	
>8	0 (0.00%)	2 (100%)	0 (0.00%)	
Parity				0.012
[0-3]	75 (92.6%)	5 (6.17%)	1 (1.23%)	
[4-7]	27 (90.0%)	3 (10.0%)	0 (0.00%)	
>8	0 (0.00%)	2 (100%)	0 (0.00%)	
History of macrosomal delivery				0.007
No	72 (96.0%)	3 (4.00%)	0 (0.00%)	
Yes	30 (78.9%)	7 (18.4%)	1 (2.63%)	
HTA				0.186
No	101 (91.0%)	9 (8.11%)	1 (0.90%)	
Yes	1 (50.0%)	1 (50.0%)	0 (0.00%)	
Diabetes type 2				0.186
No	101 (91.0%)	9 (8.11%)	1 (0.90%)	

Factors associated with macrosomia

Maternal socio-demographic, medical and gynaeco-obstetrical characteristics associated with macrosomia

The factors that were significantly associated with macrosomia were (Table V):

- Management ≥ 8 p = 0.015
- Parity ≥ 8 p = 0,012
- History of macrosomal delivery p = 0.007

Medical and obstetric conditions associated with macrosomia

There was no statistically significant relationship between the history of pathology during pregnancy and the grade of macrosomia

Discussion

Epidemiological and socio-demographic data

The hospital incidence of macrosomic newborns was lower in our study, around 4.79%, compared to other work conducted over a longer period in China in 2011 [8] (8.5%), Morocco in 2015 [9] (6.87%) and Ghana in 2015 [10] (10.5%).

Table VI. *Medical and obstetric conditions associated with macrosomia.*

Variables	**Macrosomia**			**p-value**
	Grade 1	Grade 2	Grade 3	
Gestational diabetes				0.139
No	58 (95.1%)	3 (4.92%)	0 (0.00%)	
Yes	44 (84.6%)	7 (13.5%)	1 (1.92%)	
Pregnancy-induced hypertension				0.196
No	92 (92.0%)	7 (7.00%)	1 (1.00%)	
Yes	10 (76.9%)	3 (23.1%)	0 (0.00%)	
Anemia				1.000
No	101 (90.2%)	10 (8.93%)	1 (0.89%)	
Yes	1 (100%)	0 (0.00%)	0 (0.00%)	
Hydramnios				1.000
No	100 (90.1%)	10 (9.01%)	1 (0.90%)	
Yes	2 (100%)	0 (0.00%)	0 (0.00%)	
HRP				0.097
No	102 (91.1%)	9 (8.04%)	1 (0.89%)	
Yes	0 (0.00%)	1 (100%)	0 (0.00%)	

As found in the literature, the average maternal age was 29 years [11,13,14]. Most of the mothers were illiterate and had a low socio-economic level as reported in Mali [13]. Indeed, the lack of education and the low socio-economic level lead to a lack of knowledge of hygienic and dietary measures during pregnancy and to a lack of monitoring of the pregnancy. In contrast to our study, a predominance of educated and salaried mothers was found in a study conducted in Senegal in 2019 at the Hôpital Principal de Dakar [11]. This level 4 health facility, due to its policy of accepting medical budgetary charges, welcomes a population that is mostly civil servants and therefore educated.

Maternal medical and gynaeco-obstetric data

In our study, 25% were multiparous and 3% were large multiparous, with an associative link between macrosomia and multiparity (p = 0.012). Multiparity is considered a risk factor for macrosomia. According to studies, the risk of delivering a macrosomic infant is increased in multiparous women [14]. Our result is similar to those reported in Senegal in 2017 [15], Congo [16] and Mali in 2018 [17].

The notion of a history of delivery of a macrosomic infant is also a predisposing factor to the occurrence of macrosomia as found in our study (p = 0.007) [18,19]. This fetal predisposition is linked to genetic, constitutional and nutritional factors that interact with each other.

We noted a low proportion of pre-existing diabetes and a high proportion of gestational diabetes in our study. Maternal diabetes, whether gestational or pre-existing, is a known risk factor for macrosomia [20-22]. However, some authors in Europe have found lower rates of gestational diabetes: 19% in France in 2017 [23].

Most mothers were found to be overweight or obese. Maternal obesity and excessive weight gain during pregnancy

are thought to be responsible for an increase in maternal metabolism through excessive nutritional intake, leading to excessive fetal growth and consequently macrosomia. This correlation between weight gain during pregnancy, obesity and the occurrence of macrosomia has been the subject of several studies worldwide [14,17]. According to the recommendations of the National Academy of Medicine (NAM), the Haute Autorité de Santé (HAS) and the Conseil National des Gynécologues et Obstétriciens Français (CNGOF), the ideal weight gain during pregnancy depends on the baseline BMI and should be between 9 and 16 kg for a woman with a normal pre-pregnancy body weight [24-26]. However, no association between weight gain and macrosomia was found in our study, contrary to results reported in Senegal in 2005 [27] and in France in 2017 [23].

Delivery data

According to the mode of delivery, vaginal delivery was found in 47% of cases in our series. However, there is still no clear consensus on the mode of delivery for macrosomic infants. Most scientists believe that it is inappropriate to perform a caesarean section in any patient with fetal macrosomia because of the high number of inaccuracies in the estimation of fetal weight, especially above 4500 g [28]. Our caesarean section rate is lower than the highest reported in Senegal in 2019 of 66% [11] and in Mali in 2019 of 60.9% [13].

Birth data

Regarding adaptation to extrauterine life, the majority of newborns had an APGAR score of more than 7 at 5ème minutes. This has been reported frequently in the literature [17,29]. This could be explained by better monitoring of the pregnancy and optimisation of early detection and management of risk factors for perinatal asphyxia. According to the literature, late term triples the risk of fetal macrosomia compared to births before 42 weeks' gestation [30]. As reported in several studies, the majority of deliveries were at term [31-32]. Indeed, in some situations, prolonged pregnancy due to continuous transplacental nutrient supply favours excessive fetal hypertrophy and weight gain. However, this finding may be biased by a lack of accurate dating of the pregnancy by early ultrasound or an accurate last menstrual date.

Clinical data

We have noted a male predominance. Classically, male gender is considered a risk factor for macrosomia [33-34]. According to the weight category, newborns with grade 1 macrosomia predominated in our series. This finding has been reported in other studies [10-11,13,29].

Developmental data

We noted some complications and a low mortality rate in our study of 2.61%. Indeed, macrosomia is a risk factor for neonatal morbidity and mortality due to the occurrence of cardio-respiratory and metabolic complications and obstetric trauma injuries. Complications were dominated by hypoglycaemia and obstetric trauma injuries as reported in the literature [29]. A small proportion of cardiac abnormalities were found such as septal hypertrophy, atrial septal defect and patent ductus arteriosus. All these cardiac anomalies were found in newborns of diabetic mothers in our study. In the study conducted in Senegal in 2019, no deaths were reported [11], while the study conducted in Morocco in 2014 found a rate of 3.1% [13]. Elsewhere, a lower mortality rate (0.9%) was reported in 2013 in the USA [35], and in Morocco in 2014 (0.79%) [36].

Conclusion and recommendations

Even if its incidence seems low compared to low birth weight, fetal macrosomia can lead to obstetrical and neonatal complications that can be dramatic for the mother and/or the newborn; hence the need to : improve collaboration between gynaecologists and paediatricians to ensure a low-risk pregnancy and birth; ensure that pregnant women adhere to the prenatal monitoring schedule to enable early detection and management of risk factors for macrosomia such as gestational diabetes; to encourage women to avoid morbid excess weight before and during pregnancy by respecting hygienic and dietary measures and finally to bring diabetic mothers to respect the therapeutic protocols prescribed during pregnancy in order to obtain an adequate glycemic balance during pregnancy, to ensure the continuous training of medical and paramedical staff on the management of high-risk pregnancies by quality prenatal consultations to detect and manage gestational diabetes and prevent foetal dystocia; to make the indication of caesarean section in time in order to avoid traumatic obstetric injuries at birth; to improve the technical facilities of health structures in order to ensure better care for pregnant women at risk of foetal macrosomia; to provide neonatology units with portable ultrasound monitors for early detection and management of cardiac anomalies associated with macrosomia; and to detect metabolic complications at an early stage by systematically testing capillary glycaemia in all macrosomic newborns.

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