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Martial of Hypotrophe to Lubumbashi Factors Maternal Associated with Neonatal Hypoferritinemia

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Abstract:-

Introduction
Hypotrophic newborns sometimes develop iron deficiency and neurological deficit. The objectives of the present study are : to describe the socio-demographic characteristics of mothers who have given birth to hypotrophs and to determine their erythrocyte profile as well as that of their newborns, to identify the maternal factors associated with neonatal hypoferrinemia.

Methodology
U do cross-sectional descriptive study with an analytical component, lasting 12 months was conducted in 10 health facilities in Lubumbashi in the DRC. Mothers who gave birth at term with hypotrophs without a history of hemorrhage or acute inflammatory disease during a single-fetal pregnancy were included in the study. The determination of maternal and fetal biochemical parameters were performed according to the methods recommended by the *International Federation Clinic Chemical* (IFCC) and by *the International Council of Standardization in Heamotology* (ICSH) using the Automat AU480 Beckman for ferritin and CRP and using the SYSMEX KX21N automatic device for the determination of erythrocyte parameters. The data were analyzed using SPSS.23 software.

Results
The majority of mothers are 18 35 (54.4%) ; multiparous (42.5%), of low socio-economic level (62.7%), having had malaria (66.7%), consuming Kaolin (71.6%) without taking dewormer (76%) nor iron supplementation (61.9%). They had anemia in 76.9% of cases (Hb<11gr%) with low ferritinemia (<20µg / l) in 52% of cases. Newborn small for gestational age had a normal hemoglobin (Hb≥13, 5 gr%) in 73.9% of cases and a low férritnémie (<60µg / L) in 32.8% of cases. The maternal determinants of neonatal hypoferrtinemia are maternal malaria (OR .113.43 [9.42-1364.53]), the birth interval less than 12 months (OR48.18 [6.37-364.57]), not taking dewormers (OR : 16.26 [2.04-129.50]) or iron supplementation during pregnancy (OR7.03 [1.55-31.90]).

Conclusion
The present study shows that hypotrophic newborns do not always have iron deficiency anemia. Iron supplementation should not be systematic in these newborns at birth but it will require an iron assessment (hemoglobin and serum ferritin) beforehand.

Keywords:- *Low Birth Weight, Maternal Determinants, Neonatal Hypoferritinemia, Lubumbashi, DRC.*

I. INTRODUCTION

Iron is an essential micronutrient, mainly to ensure the transport of oxygen or to catalyze reactions of electron transfer, nitrogen fixation , synthesis of deoxyribonucleic acid (DNA) and plays an important role in the differentiation or the cell proliferation. The ferritin assay indirectly measures the amount of iron in the blood. A low value of ferritin in serum is usually a good indicator of e the iron deficiency. In pregnant women, iron deficiency p had t cause a risk of growth retardation intrauterine (IUGR) and move to a low birth weight (LBW) , increasing the risk of morbidity and mor t neonatal atilité short and long term [1–3] .

In countries with resource s limited low birth weight is a real health problem because the high cost of care in neonatal units do not allow people to enjoy a better supported. Hence knowledge of the maternal factors associated with hypoferritinemia will make it possible to initiate treatment programs in order to reduce the rate of low birth weight [4] .

In 2016 , the United Nations report states that worldwide 5.6 million children died before reaching their fifth birthday and 46% of them died within the first 28 days of their lives . This rate is the lowest compared to previous years. Despite this progress, 60 million children will die before the age of 5 by 2030 if social inequalities are not reduced [5] .

Low birth weight is implicated in 60 to 80% of neonatal deaths. The global prevalence of low birth weight is 15.5%, which represents about 20 million low birth weight infants each year, 96.5% of them born in developing countries. development [6.7] .

T he neonatal and infant mortality rate can be reduced by improving maternal care during pregnancy, childbirth and the care of low birth weight infants.

But in sub-Saharan Africa in general and the DRC in particular , joint efforts by the s Ministry s health public in disponibilisant certain intervention packages to reduce neonatal mortality is nt enough s. To this is added the widespread poverty th of the population, the low level of education, the diet unbalanced , some dietary restrictions related to certain customs and certain parasitic diseases . I s should be s ignaler that the esnsemble of these factors lead to deficiencies of some essential micronutrients , including iron . The study by Beard et al . has shown that has iron deficiency in the mother can conduir e in low birth weight following the stress oxidative via placental endothelial dysfunction and that these infants low birth weight are often prone to iron deficiency [8] . As a result of this iron deficiency, newborns with low birth weight can develop anemia due to lack of hemoglobin production ; of s disorders growth, development of cognitive function and motor by the defect of myelination of the synthesis of monoamines and energy metabolism s glial cells and s neurons of the central nervous system . Thus iron deficiency in pregnant women in a context of poverty worsens neonatal morbidity and mortality [9] .

The objectives of this work are : (1) to describe the socio-demographic characteristics of mothers who have given birth to hypotrophic newborns ; (2) determine the erythrocyte profile of mothers and hypotrophs, in particular the mean globlary volume (MVV) and the mean corpuscular hemoglobin concentration (C CMH), as well as the iron status of hypothrophs, in particular hemoglobin and serum ferritin ; (3) identify the maternal determinants associated with hypoferritinemia in hypotrophic neonates.

II. METHODOLOGY

II.1. Study place

The study was conducted in Lubumbashi , a city situated e to 1230 meters altitude in an area Sickl anemia and malaria in the Democratic Republic of Congo (DRC). Ten medical and health structures were selected in particular : the University Clinics of Lubumbashi, the Jason Sendwe hospital, the HGR Kenya, the Sainte Bernadette maternity , the CS Mama wa Huruma, the CS Mery center, the CS Kenya 1, the CS Imani Mgr Nsolotshi and AENEF. The selection of these medical and health facilities was made in a reasoned choice , taking into account the criterion è res following :
- To welcome at least 300 new pregnant women per year in prenatal consultation and for prenatal care ;
- Be accessible to all social strata of the population ;
- A nsure deliveries ;
- have a mother-child protection service (PMTCT) for the management of HIV infection.

II.2. Type of study:

This is a cross-sectional descriptive study with an analytical component, covering the period from April 10, 2019 to May 12, 2020 .

II.3. Study population and sampling

The study population consisted of 134 mother - newborn couples . Our was made up exhaustively .

II.3.1. Inclusion criteria

We included in this study ; mother-newborn couples meeting the following criteria :
- **M era** have consented freely to participate in the study and ay ant not presented a haemorrhage during pregnancy or acute inflammatory disease ;
- **N ew-term infants** , from a singleton pregnancy without transfusion history and showing no pathology acute inflammatory .

II.3.2. Non-inclusion criteria

The criteria for non-inclusion in this study are as follows :
a) For the mother
Mother with jaundice, sickle cell disease or thalassemia, caesarized , with pulmonary tuberculosis and on antituberculosis , recently transfused (less than 4 months), on antimitotic, with large spleen and / or large liver, febrile, with CRP (≥ 6 mg / l).

b) For the newborn
Newborn with jaundice , polymalformed, with infectious stigma (sepsis), with fetal-maternal ABO and / or rh incompatibility, recently transfused, born with depressed APGAR, under iron supplementation, ill at the time of selection , with CRP (≥ 6 mg / l) .

II.4 Parameters or study variables and definitions of concepts

II.4.1. For the mother :

a) Sociodemographic characteristics
- **Age mother (years) and maternity risk** ;
maternity at risk : <18 years and >35 years
m aternité safer : 18-35
- Marital status (living alone e or living with a partner) ;
- Activity daily (generating business income or non-regenerative revenue) ;
- Socio- economic level :

The socio-economic level was assessed from the calculation of the poverty index as defined in a survey carried out in DR Congo in 2001, the Multiple Indicator Cluster Survey (MICS2) [10] . It is a measure made up of household characteristics: material of the floor, nature of the roof and walls of the dwelling , property belonging to the household, occupancy status of the dwelling; the availability and duration of food reserves. This measurement of 36 points in total, allowed us to group the births into low socio-

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economic levels (≤ 20 points), medium (21-24 points) and high (≥ 25 points) depending on the distribution . The DRC is a country with limited resources, we avo purposes described in this study of a cceptable socioeconomic levels m iddle or high in the analytical part .

- Parity : nulliparous (Po), primiparous (P1), pauciparous (P2-3) and multiparous (P≥4) [11] ;
- Nutritional status : the assessment indicator is MUAC (MUAC) : poor nutritional status : MUAC <24 cm, good nutritional status : MUAC ≥ 24 [9,12,13]
- Level of studies : Low, if it is less than or equal to 8 years of studies (2 nd of the secondary cycle) ; Acceptable if it is over 8 years [14] .

b) Maternal protection activities during pregnancy
- **Antimalarial prophylaxis :** Intermittent presumptive treatment of malaria (IPT) and use of the long-lasting impregnated mosquito net (LLIN)
- Iron supplementation
- Parasite intestinal (t reatment presumptive verminoses) : administration of mebendazole .

c) Food and environmental habits
- Consumption of tea during pregnancy
- Coffee consumption during pregnancy
- Alcohol consumption during pregnancy
- Tobacco use during pregnancy
- Geophagy during pregnancy (consumption of Kaolin)
- Food prohibited during pregnancy

d) Pathologies during pregnancy
- arterial hypertension
- Diabetes
- Malaria

II.4. 2 . Erythrocyte Parameters and C-Reactive Protein (CRP)
a) In the mother
- Mean Globular Volume (MCV) [<80 µm 3 or fL (femtolitre) : microcytic, 80-100 µm 3 or fL : normocytic, >100 µm 3 or fL macrocytic [15]
- Mean Corpuscular Hemoglobin Concentration (CCMH) : g / dl (hypochromia <30, normochromia : 30-34, hyperchromia>34) [15]
- Reactive C protein (CRP) : the assay was carried out by the qualitative and semi-quantitative method. CRP is considered pathological if its value is greater than or equal to 6 mg / l

b) In the newborn
- Mean Corpuscular Volume (MCV) [<80 µ m 3 or fL (femtoliter) : in character microcyt area , 80-100 .mu.m 3 or fL : normocyt area , >100 .mu.m 3 or fL to macrocytic character [15]
- Mean Corpuscular Hemoglobin Concentration (CCMH) : g / dl (hypochromia <30, normochromia : 30-34, hyperchromia>34) [15]
- Reactive C protein (CRP) : the assay was carried out by the qualitative and semi-quantitative method. The CRP e st considered e as pathological if its value is greater than e or equal to 6 mg / l.

II.4. 3 . S tatut martia l
It was defined by the measurement of hemoglobin and serum ferritin,
a) In the mother
- Hemoglobin (g / dl) in pregnant women : a rate of hemoglobin ≥11 (Normal) , from 8 to 10.9 (Anemia m oderate) , <8 (a severe némie) [16]
- Serum Ferritin (g / l) : hypoférrinémie is considered a value of serum ferritin below 2 0 g / l [17] .
- If serum ferritin between 12 - 20 µg / l : iron deficiency [17] ,
- If serum ferritin < 12 µg / l : iron deficiency anemia

b) In the newborn
- Rate hémogl obine (g / dl) : anemia is defined in the newborn by a hemoglobin of less than 13, 5 g / dl , [15] .
- Serum ferritin : µg / l. : hypoferritinemia in newborns is defined by a ferritin value of less than 60µg / l [17,18] .

If serum ferritin between 30 - 60 µg / l : iron deficiency,
If serum ferritin < 30 µg / l : iron deficiency anemia

The venous sample was taken in the morning at 7 am in the fasting child for 8 hours at the level of the elbow fold, the tourniquet being loosely tightened . E t at the level of the umbilical vein in the newborn . The assay was carried out according to the methods recommended by the *International Fe de ration Clinic Ch e mi cal* (IFCC) and by *the International Council of Standardization in Heamotology* (ICSH). We used the AU480 Beckman coulter chemical analyzer to measure ferritin and CRP. And the SYSMEX KX21N hematological machine for the determination of erythrocyte markers. Serum ferritin assay was coupled with CRP in order to rule out cases of acute inflammatory syndrome that could influence serum ferritin.

II.5 Data analysis
Data processing was carried out using Epi Info 7.2.2.6 and SPSS version 23.0 software.

For the univariate analyzes , we determined the absolute and relative frequencies and the position (mean, median and mode) and dispersion parameters for the quantitative variables.

Concerning the bivariate analyzes, we studied the association between some variables and their degree of significance, the p-value, the threshold of which was set at 5%. Pearson's or Yates' corrected chi-square test was used or , failing that, the Fischer test.

The biases were eliminated by the regression logistics . A insi , we carried out a multivariate analysis according to Mantel-Haenszel statistics . Reports of coastline (OR) and 95% confidence intervals to assess associations between 're independent and variable dependent s and the significance of factors associated with low fe rritine were also made . For the adjustment, we retained the variables from the threshold

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of p≤0.2 and the independent variables with significant clinical significance were forced to integrate the model. Variables with a strong significant correlation were pruned from the model.

A decriminal analysis by the ROC curve (Receiver Oparating Characteristic) or performance characteristic curve made it possible to calculate the percentage or the probability of these maternal determinants of causing neonatal hypoferritinemia (serum ferritin < 60 µg / l) in hypotrophic newborns .

The protocol research of this is study was odopté by the university clinics Department of Pediatrics Lubumbashi and subject to approval of the Committee of Ethics of the University of Lubumbashi under approval number : UNILU / EMC / 094 / 2018.

II.6 Limits of the study

In the present study, only maternal and fetal extrinsic factors were exploited to investigate the relationship between maternal predisposition , onset of low weight and low ferritin level. We did not realize the intrinsic analyzes during pregnancy in pregnant (placental biopsy to search for e pathology or dysfunction) or search for pathology s congenital s related s fetus itself.

III. RESULTS

III . 1. Features sociodemographic s mothers and low birth weight

Table I : Distribution of mothers s ccording characteristics socio demographic

Sociodemographic characteristics	Workforce (n = 134)	Percentage	M ± SD or median
Mother's age (year)			
<18	45	33.6	
18-35	73	54 , 5	
>35	16	11.9	
			25.79 ± 6
Daily activity			
Revenue generating activity	70	52.2	
Non- revenue generating activity	64	47.8	
Economic level			
Low	84	62.7	
Way	37	21.6	
Raised	13	9.7	
Mother's height (cm)			
<150	7	5, 3	
≥150	127	94.7	
			163.7 ± 7.6
Parity			
Primiparous	53	39.6	
Pauciparous	24	17.9	
Multiparous	57	42.5	
			3
MUAC (cm)			
<24	16	11.9	
≥24	118	88.1	
			26.1 ± 2.2
Intergenesic space (months)			Median
<12	51	38.1	
≥ 12	83	61.9	
			20

M : mean AND : standard deviation

Analysis of Table I shows that among mothers who gave birth to hypotrophs :

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- 54 , 5 % are between 18 -35 years and 42.5% were multiparous ;
- 52.2% have a revenue-generating activity and 62.7% have a low socio-economic level ;
- 5, 3 % have a size less than 150 cm and 88.1% have an arm circumference greater than 24 cm
- 61.9% have an intergenerational space greater than or equal to 12 months.

III .2. Pathologies during pregnancy, eating habits, toxic exposures, antimalarial prophylaxis and low birth weight

Table II : Distribution of mothers according to pathologies during pregnancy, eating habits, toxic exposures, antimalarial prophylaxis

Settings	Effective	Percentage
Iron supplementation		
O ui	51	38.1
No one	83	61.9
Interference suppression (p ting s vermifuge s)		
Yes	39	44.0
No	95	56.0
Malaria		
Yes	88	65.7
No one	46	34.3
I nterdits food		
Yes	33	24.6
No	101	75.4
Consumption of tea or the coffee		
O ui	104	77.6
No one	30	22.4
Geophagy (consumption of Koali)		
O ui	96	71.6
No one	38	28.4
CO2 exposure (Cooking with wood / charcoal)		
O ui	134	100.0
No one	0	0.0
Hypertension in pregnancy		
Yes	8	6.0
No	126	94.0
Smoking		
Yes	1 9	1 4 , 1
No	11 5	8 5 , 9
Antimalarial prophylaxis (IPT or LLIN)		
Yes	5	3.7
No	129	96.3

The e Table II shows that 38.1 % of mothers received supplementation with iron during pregnancy. In 56.0% of cases , they did not benefit from deworming and in 65.7 % of cases malaria was treated . In 24.6% of cases the observance of dietary restrictions was observed . Tea consumption, geophagy was 77.6 % and 71.6 % of cases, respectively. In connection with the notion of pressure on gro cy, smoking and to use of LLINs , the last eras were observed in 6.0 ; 1 4 , 1 % and 3.7% of cases.

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III.3. P arameters erythrocyte maternal and ferritin

Table III : Distributions of mothers according to maternal erythrocyte parameters and ferritin

Maternal erythrocyte parameters and ferritin	**Workforce (n = 134)**	**Percentage**	M ± ET or Median
Hemoglobin (g / dl)			
≥11 (Normal)	31	23.2	
From 8 to 10.9 (anemia m oderate)	74	55.2	
<8 (Severe anemia)	29	21.6	
			10.0 ± 1
VGM (µm ^{3} or fL (femtoliter)			
<80 (microcytic)	29	21.6	
80-100 (normocytic)	88	65.7	
>100 (macrocytic)	17	12.7	
			85 ± 7.6
CCMH (g / dl)			
<30 (hypochromic)	37	42.5	
30-34 (normochrome)	97	57.5	
>34 (hyperchrome)	-	-	
			29.5 ± 1.6
Ferritin (µg / l)			
<20 (low or hypoferritinemia)	70	52.2	
≥20 (Normal)	64	47.8	
			42

M : mean AND : standard deviation

By analyzing Table III , we find that the hemoglobin level was low in 76.9% of cases including 55.2 % moderate anemia and 21.6% severe anemia , the MCV low in 21.6. % of cases , low CCMH in 42.5 % of cases and low fever in 52.2%.

Hypotrophic newborn sex

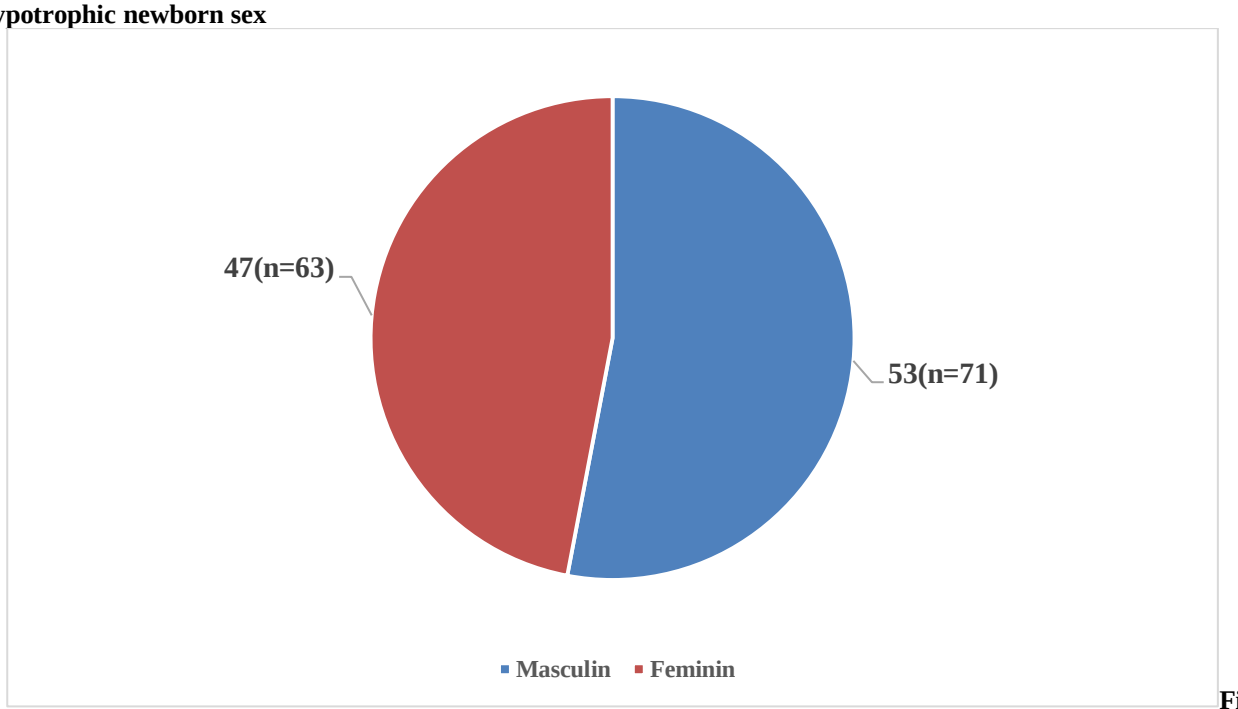

Figure 1 : Distribution of hypotrophs by sex

It emerges from this figure that 71 hypotrohes or 53.0% were male . The sex ratio being 1.13 in favor of the male sex

III.4. Erythrocyte parameters of hypotrophs and ferritin

Table IV : Distributions of hypotrophs according to erythrocyte and ferritin parameters

Erythrocyte and ferritin parameters	Effective	Percentage	M ± ET or Median
Hemoglobin (g / dl)			
<13.5 (anemia)	21	15.7	
≥ 13.5 (normal)	113	84.3	
			16.9 ± 3
VGM (µm ^{3} or fL (femtoliter)			
<80 (microcytic)	9	6.7	
80-100 (normocytic)	93	69.4	
>100 (macrocytic)	32	23.9	
			97 ± 19
CCMH (µm ^{3} or fL (femtoliter)			
<30 (hypochromic)	39	29.1	
30-34 (normochrome)	83	61.9	
>34 (hyperchrome)	12	9	
			30 ± 3
Ferritin (µg / l)			
<60 (low or hypoferritinemia)	44	32.8	
≥60 (Normal)	90	67.2	
			53

M : mean AND : standard deviation

Table V shows that in 15 , 7 % of cases the hemoglobin was less than the normal value should be anemia , with a VGM normal in 69.4% of cases , a normal MCHC in 61.9% of cases and ferritin normal in 67.2% against 32.8 of cases of low ferritinemia.

Schematic summary of the martial status of the hypotrophic newborn

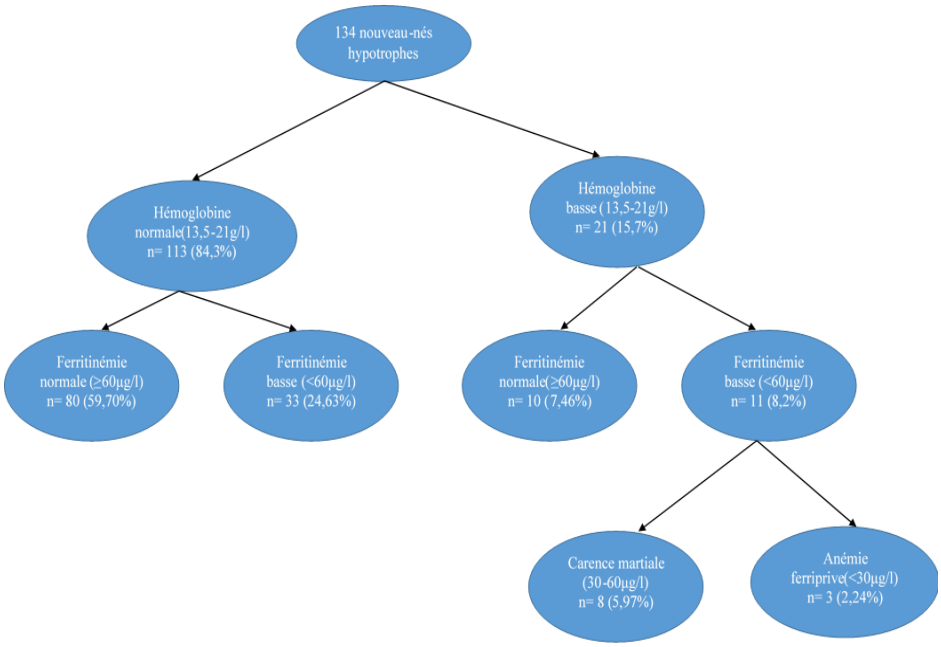

Figure 2 : Schematic summary of the martial status of the hypotrophic newborn

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It emerges from this diagram that iron deficiency anemia represented 2.24% of all hypotrophs, while iron deficiency without anemia represented 24.63%. Shallow iron deficiency associated with low hemoglobinemia was present in 5.97% of cases and normal ferritinemia associated with normal hemoglobin in 7.46% of cases. hypotrophs with normal hemoglobinemia and normal ferritinemia constituted the majority of the sample, ie 59.70% of cases.

III . 5 . Maternal factors associated with neonatal hypoferritinaemia

The results of the test of association between the studied variables maternal and neonatal hypoferritinemia, in particular, Odd 's ratio of gross, the 95% confidence intervals and p <0.05 are presented in the table below :

Table VI : Serum Fe rritin Levels in Newborns and Maternal Parameters

Settings		**Ferritin level**			
Maternal age (years) and maternity at risk	not	Low	normal	p	OR [95% CI]
<18 and >35 years (Maternity at risk)	61	11 (18 , 0)	50 (8 2.0)	0.002	0.3 [0.1-0.5]
18-35 years (Maternity to lesser)	73	3 3 (4 5 , 2)	40 (5 4 , 8)	0.000	1
Socio-economic level					
Low or low	84	21 (25.0)	53 (75.0)	0.282	1.7 [0.6-3.6]
Acceptable (m edium + high)	50	23 (46.2)	27 (53.8)		1
MUAC (cm)					
≥ 24	118	29 (24.6)	89 (75.4)		1
<24	16	15 (93.8)	1 (6.3)	0.000	46.03 [5.82-363.7]
Intergenesic space (months)					
≥ 12	83	16 (19.3)	67 (80.7)	0.000	1
<12	51	28 (54.9)	23 (45.1)		5.09 [2.3-11.0]
Parity					
Primiparous	53	8 (15.1)	45 (84.9)	0.002	1
Pauciparous	24	12 (50.0)	12 (50.0)		5.6 [1.8-16.6]
Multiparous	57	24 (42.1)	33 (57.9)		4.0 [1.6-10.2]
Iron supplementation					
Yes	51	14 (27.5)	37 (72.5)		1
No	83	30 (36.1)	53 (63.9)	0.298	1.4 [0.69-3.2]
Intestinal deworming (taking dewormers)					
Yes	39	5 (12.8)	34 (87.2)	0.002	1
No	95	39 (41.1)	56 (58.9)		4.4 [1.7-13.2]
Malaria					
Yes	88	27 (30.7)	61 (69.3)	0.462	1
No	46	17 (37.0)	29 (63.0)		0.75 [0.35-1.5]
Food prohibited					
Yes	31	19 (61.3)	12 (38.7)	0.000	1
No	108	25 (24.3)	78 (75.7)		0.20 [0.08-0.47]
Consumption of tea or coffee				0.000	
No	30	20 (66.7)	10 (33.3)		1
Yes	104	24 (23.1)	80 (76.9)		0.15 [0.06-0.36]
Geophagy (Kaolin Consumption)				0.000	
No	38	22 (57.9)	16 (42.1)		1
Yes	96	22 (22.9)	74 (77.1)		0.21 [0.09-0.48]
Hypertension during pregnancy				0.626	

No	126	42 (33.3)	84 (66.7)		1
Yes	8	2 (25.0)	6 (75.0)		0.66 [0.12-3.44]
Smoking				0.001	
No	118	33 (28.0)	85 (72.0)		1
Yes	16	11 (68.8)	5 (31.3)		0.17 [0.05-0.54]
Anti-malaria prophylaxis (IPT and LLIN)				0.012	
Yes	5	4 (80.0)	1 (20.0)		1
No	129	40 (31.0)	89 (69.0)		0.11 [0.05-0.54]

Table VI shows a statically significant difference between the low ferritin level and maternal age < 18 and >35 (OR : 0.3 [0.1-0.5] p = 0.002), the acceptable socio-economic level (OR 2.2 [1.0-5.1] p = 0.004 and OR 3.5 [1.0-11] p = 0.032), MUAC less than 24 cm (OR : 46 03 [5,82- 363.7] p = 0.000), the pauci parity (OR : 5.6 [1.8 to 16.6]) multiparity (OR : 4.0 [1.6 to 10, 2] p = 0.002), the birth interval less than 12 months (OR : 5.09 [2.3-11.0] p = 0.000), taking dewormer (OR : 4.4 [1.7- 13.2] p = 0.000), tea consumption and / or coffee (oR : 0.15 [from 0.06 to 0.36] p = 0.000), food prohibited s during pregnancy (oR : 0, 20 [0.08-0.47], p = 0.000), geophagy during pregnancy (0.21 [0.09-0.48] p = 0.000), and smoking during pregnancy (OR : 0.17 [0.05-0.54], p = 0.000).

III. 6 . Maternal determinants of neonatal hypoferritinemia

The logistic regression model focused on maternal variables for which univariate analysis showed an association with neonatal hypoferritinemia. The TableA u VII gives O dd ratio s adjusted, the 95% confidence intervals and e p taken at the threshold of less than 0.05 for the variables whose association with hypoferritinemia persisted after logistic regression.

Table VII : D determinant s maternal of hypoferritinemia among newborns hypotrophe

Maternal determinants	OR [95% CI]	p
Intergenesic space less than 12 months	48.18 [6.37-364.57]	0.000
Non- iron supplementation	7.03 [1.55-31.90]	0.011
Non-deworming (not taking dewormers)	16.26 [2.04-129.50]	0.008
Malaria	113.43 [9.42-1364.53]	0.000

It appears from this table that after adjustment, the association with neonatal hypoferritinemia some maternal variables has persisted . This is malaria (OR : 113.4 [9.429 - 1364.533]) which has increased the risk of low serum ferritin level in the hypotroph by 113, from the birth interval of less than 12 months (OR : 48.185 [6.369 - 364.573]) that increased the risk by 48, of the non-decision- s worming (OR : 16.260 [2.042 - 129.505]) that increased the risk by 16 and the non iron supplementation (OR : 7.037 [1,552 - 31,909]) which multiplied the risk by 7.

III.7. P robability four determinants of maternal cause a hypoferritinemia in nou calf born hypotroph es

A descriminante analysis curve ROC (Receiver Oparating Characteristic) or performance characteristic curve allowed to calculate the percentage or proba bi lity of these maternal détermiants to cause a neonatal hypoferritinemia (ferritin serum < 60µg / l) in newborn born hypotrophic .

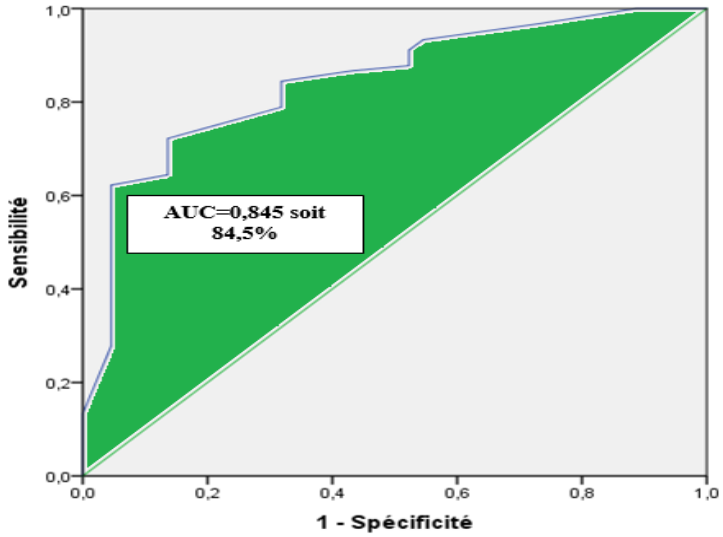

Figure 1 : ROC curve

Figure 1 shows that the percentage or the probability of the 4 maternal determinants of causing neonatal hypoferritninemia is 84.5% (AUC : area below the curve = 0.845 [0.776-0.914]) .

IV. DISCUSSION

VI.1. sociodemographic mothers

Age

Our study shows that in 54 , 5 % of cases, small for gestational age were born to mothers aged 18 - 35 years. Tshinzobe et al. [19] found 69.9% in the same age group . Mengesha et al. [20] found a higher proportion of low birth weight newborns in the maternal age group over 18 years, without this difference being statistically significant. Some authors have not found a relationship between maternal age and growth [21,22] .

Maternal age of less than 20 years is commonly associated with low birth weight [14] . This observation has been made by several authors. El Bakki et al [23] avai in t found a significant association between maternal age less than 18 years and the small birth weight. And concluded that this result could be explained by the fact that these young pregnant women have not yet completed their growth and that they use the large part of the nutritional intake for their own growth at the expense of fetal growth.

Kangulu et al. [24] with 42.2% of cases aged less than 18 years , avai in t found that women aged less than 18 years were 7.6 times more likely to have infants of low weight than older mothers . Moyambe et al. [25] , Frisangho et al . [26] and Mafina-Mienandi et al. [27] also reported young maternal age (less than 18 years) as a factor associated with IUGR.

Daily activity or occupation and socio- economic level

In our study , 52.2% of women who gave birth to hypotrophs had silver regenerating activity. In 62.7 % of cases they had a low socio- economic level although they had a regenerative activity of revenues .

Several studies show nt than years the majority of cases, are newborns at term small for gestational age are the mothers of low socioeconomic [9] .

Cer tain authors have also found that mothers without generating activity of revenues (without occupation) gave birth to the new- born low weight in the majority of cases [28-30] . Moyambe et al. [25] and Karim et al. [31] had found in their studies, that there is a significant association between the low socio-economic level of the pregnant woman and the IUGR. Indeed, the low socio-economic level is often the cause of a poor nutritional state which leads to IUGR [32] .

Cut

In our study 5.3% of mothers who gave birth to hypotrophs had a height of less than 150 cm.

The short stature of pregnant women is generally recognized as a factor associated with fetal hypotrophy [21,33] . El Bakki et al [23] in his study , had o bserve a combination significantly between the size of the pregnant woman and small birth weight. The risk of hypotrophy is 6 times higher if the patient's height is less than 155 cm. Moyambe et al. [25] avai in t also observed a significant association between the size of the pregnant and IUGR. The risk of IUGR is twice as high if the pregnant woman's height is less than 155 cm. Indeed, in a small woman there is a decrease or a low cardiac systolic ejection volume which does not lead to a decrease in utero-placental perfusion with a deficient transfer of nutrients from the pregnant woman to the fetus thus leading to IUGR. [25] .

Scott and Usher [34] had meanwhile found that this factor is not sig nificativement associated with IUGR.

Parity

In our study 42.5% of women who gave birth to hypotrophs were multiparous. D at very authors also found more than multiparous among the omen that gave rise to small for gestational age, but there is a statistically Association significant. [35.36]

Kangulu et al. [24] just like Tshinzobe et al. [19] had found , unlike us, more first-time mothers who were affected respectively 24.4 % of cases , and 40.8 % . All had found a statistically significant link between primiparity and the occurrence of low birth weight.

Kayasta et al had shown that multiparity was a risk factor for low birth weight [37] .

In addition, Wachamo et al in 2019 in hospitals in the North Wello zone in Ethiopia reported that parity was not the only risk factor for low birth weight [30] .

Thus it is possible in our study that the multiparas presented other risk factors which were at the base of the low weight of their children.

Inter-reproductive space

In our study, 38.1% of mothers had a birth interval of less than 12 months linked to hypoferritinemia . Endalamaw et al , found that the risk of giving birth to a low birth weight newborn was tripled each time the parturient had an birth interval less than 24 months (AOR = 2, 8; CI [1.4–4.2]) [38] , Moyambe et al. T et al [25] came to the same conclusion for an birth interval of less than 12 months.

The rained share of studies show how consistent a period of time between pregnancies is associated with low birth weight [27,39] . Indeed, when the interval is short, that is to say less than 18 months, the mother may not have had time to replenish adequate reserves of nutrients and is at risk of experiencing more stress, which can influence intrauterine growth. In addition, when the birth interval is longer, that is to say more than 60 months, the risk of premature delivery and intrauterine growth retardation increases since the reproductive capacities of the mother decline over the years. following a first pregnancy [40] .

Moreover in the USA, Rawlings reported the association with the inter-reproductive interval of less than 9 months [41] . In his study, he found that the shorter the inter-reproductive interval, the greater the risk of IUGR and, consequently, the occurrence of a low birth weight child. The increased risk of PNP in this case would be due to the fragility of the maternal organism, which has not yet replenished its reserves of micronutrients and vitamins necessary for the good progress of a new pregnancy [42] . In addition, the uterus has not yet completely regained its position, shape and physiological state. The mother is also under stress, which can negatively influence intrauterine growth .

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MUAC

In our series, maternal MUAC greater than 24 cm was observed in 88.1% of women who gave birth to hypotrophs .

Moyambe et al. observed that MUAC was significantly related to IUGR in univariate analysis and the risk of IUGR was 2 times higher for MUAC less than 24 cm [25] . C ette observed tion joined those of other studies including those of Ra m nakrishman [43] , and and Chabra Bhandari [44] .

It is possible to be in good nutritional status and to be iron deficient as our results on maternal serum ferritin levels show. And the impact of maternal iron deficiency on birth weight is clearly documented at these [8,45,46] .

If x e Newborn

D -year 53.0% of cases , the male sex were small for gestational age in our series . Tshotetsi et al as Tshinzobe et al avai in t reported a similar result [19,47] . Moyambe et al. also found the male sex, but no association was found between the sex of the newborn and the low weight of [25] .

Some authors noted in their study s , girls représentaien t the majority of newborns of low weight birth [48,49] .

VI.3. Pathologies during pregnancy, eating habits, toxic exposures, prophylaxis activities

High blood pressure during the pregnancy

Our study shows that 6.0% of mothers who gave birth to hypotrophs were hypertentensive. Our results showed hypertension due to pregnancy in 6.0% of cases . Hypertension in pregnant women is a known cause of IUGR [21,22,33] . Hypertension causes a reduction in the maternal blood supply to the placenta, by a decrease in uteroplacental flow and this decrease disrupts exchanges thus causing intrauterine growth retardation. Moyambe et al. T [25] with 19.5% of cases , found that there is a significant association between arterial hypertension and IUGR (p = 0.02). The risk for a pregnant hypertensive woman to have a fetus with IUGR is twice as high as for a non-hypertensive pregnant woman (OR = 2.44).

El Bakki et al. , Pusdekar et al avai in t also observed that arterial hypertension in pregnant women was significantly associated with the occurrence of low birth weight [23,49] .

P aludism

In our series , 65.7% of the mothers had malaria (thick gout) . In areas of endemic transmission, malaria during pregnancy is a common cause of maternal anemia and low birth weight. There is a considerable interaction between maternal malaria and anemia in their effects on birth weight [21] . Moyambe et al. [25] had found that the risk of IUGR is 2 times higher in a pregnant malaria than in the non-malarious (OR = 1.95).

It is now clearly established that malaria during pregnancy is a risk factor for low birth weight [40] .

Iron supplementation and taking vermifuge s

In 38.1 % of cases , the mothers are benefited from supplementation with iron do nt 6% in the third quarter of the pregnancy. In 56.0% of cases , they did not benefit from deworming . This result shows that in the majority of cases , pregnant women do not benefit from most of the intervention package provided for in accordance with the refocused ANC standard. In our study, the risk of low ferritin levels was multiplied by 4 if the mother had not taken dewormer (OR : 4.4 [1.7-13.2] p = 0, 000).

According to McCarthy et al , the use of iron, with or without folic acid, led to a 50% reduction in the risk of anemia in the third trimester or at childbirth [50] .

The importance of overall maternal health and lifestyle for neonatal iron status was emphasized. Public health policies and health promotion interventions for women of childbearing age are needed along with the promotion of a healthy lifestyle among young women, essential to protect generations [50] .

Martial status of the mother

Hemoglobin

Our study shows that the mothers are giving birth of small for gestational age ed was anemic in 76.9% of cases with 55, 2% of moderate anemia and 21.6% of severe anemia . Moyambe et al. [25] avai in t observed that maternal anemia was significantly associated with u n intrauterine growth retardation Ute rine (p = 0.02) .

On the other hand, Kanya et al. [51] , Alwan et al [52] found that maternal anemia was not associated e to intrauterine growth retardation.

Ferritin

We observed in our study that 52.2% of mothers had serum hypoferritemia (<20 µg / l) . N ur result is similar to that of Agarwal et al [53] . who have observed in their series that e maternal hypoferrinémie was not significantly associated with low birth weight . He explains this finding by the fact that the a concentrate ion maternal ferritin NCI laughing th to 12 g / l is the threshold likely below which fetal accretion ferritin is affected.

Kanya et al. has vaient , by con be , found ferritin normal (40 +/- 67 ug / l) in the majo women who gave birth rity of small for gestational age p = 0.4 insignificant [51] .

Martial status of the newborn

Hemoglobin

We observed in our study that in 84.3% of cases the hemoglobin of hypotrophs was normal (13.5-21 g%) . Our result is similar to that of Mac Queen [54] had found normal hemoglobin in her series .

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Kanya et al [51] t out as Jansson [55] reported an e insignificant levation of h e mog Lobine mie ch ez infants small for gestational age.

Ferritin

In our series , neonatal serum ferritin was low in 32.8% of cases including 8.21% iron deficiency anemia and 24.63% iron deficiency without anemia. Mac Queen et al. [54] and Kanya
M et al. [51] avai in t also very oved ferritin crumb 11 g / L in infants small for gestational age .

Agarwal et al. [53] avai in t found for their low ferritin levels but was not significantly associated with low birth weight in 2.3% of cases . Low birth weight is often associated with deficiency [56]

Maternal determinants of neonatal low ferritin

In our study, the maternal determinants of hypoferritinemia are maternal malaria (OR : 113.4 [9.429 - 1364.533])
which increased the risk of low serum ferritin level in hypotrophs by 113, from space intergenesic less than 2 years (OR : 48.185 [6.369 - 364.573]) that increased the risk by 48, from not taking worming (OR : 16.260 [2.042 - 129.505]) that increased the risk by 16 and non supplementation iron (OR : 7.037 [1.552 - 31.909]) which multiplied the risk by 7.
The probability for these four maternal determinants of causing neonatal hypoferritinemia is 84.5% (AUC according to the ROC curve = 0.845) .

Several authors have studied the link between the status martia the breast and iron status neonatal to see their degree ed association. Thus, some have argued that neonatal martial status was not influenced by any maternal parameters . Others have found a link between maternal martial status and neonatal martial status [18] .

V. CONCLUSION

The present study shows that the majority of mothers who gave birth to hypotrophs are aged 18 to 35 , multiparous, of low socio-economic level , having had malaria, consuming Kaolin , without taking dewormer or iron supplementation .

hypotrophic newborns have a normal hemoglobin level for the most part, on the other hand the 20 do not always have iron deficiency anemia. Iron supplementation should not be systematic in these newborns at birth but it will require an iron assessment (hemoglobin and serum ferritin) beforehand.

The present study shows that low birth weight is linked to neonatal hypoferritinemia which thus reflects iron deficiency anemia. The maternal determinants of this hypoferritinemia are malaria, the birth space less than 12 months, intestinal parasitosis and no iron supplementation during pregnancy.

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Competing conflicts of interest

None declared

Contributions from the authors

All authors have read and approved the final version of the manuscript.

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