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Seroprevalence profile of antibodies against measles in mother–child pairs in Libreville (Gabon) in 2024

Abstract

Introduction: The occurrence of measles in the neonatal period is possible if the newborn is born to a mother who does not have natural or vaccine-induced immunity. Our objective was to assess the seroprevalence of antibodies against measles in mother-child pairs in Libreville from October 1, 2023, to March 31, 2024.

Patients and methods: This was a multicenter, prospective, cross-sectional study with descriptive and analytical objectives conducted over a 6-month period. The study population consisted of mother-infant pairs admitted to the delivery room in five public health facilities in Libreville. Demographic data for the mothers and newborns, as well as data relating to the mothers' vaccination status, were analyzed.

Results: 92 mother-child pairs were included. The average age of the mothers was 27.40 ± 6.70 years (range 17 to 44 years). In 68.50% (n=63) of cases, the vaccination status was unknown; the mothers were students (44.60%) and primiparous (56.50%). Measles-specific immunoglobulin G (IgG) antibodies were detected in 82.60% of pregnant women. In newborns, measles-specific IgG antibodies were present in 76.10% of cases. A strong correlation was observed between the levels of measles-specific IgG antibodies in newborns and those in their mothers ($r = 0.87$; $p < 0.0001$).

Conclusion: A large proportion of pregnant women has protective levels of measles antibodies and transfers them to their newborns. However, some mothers remain below the recommended threshold. It would be advisable to advocate for the vaccination of women of childbearing age.

Keywords: seroprevalence, measles antibodies, mother-child, Libreville-Gabon

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Introduction

Measles is a highly contagious viral infection that causes a rash and confers immunity.[1,2] It most commonly affects children under five years of age and immunocompromised adults. The World Health Organization (WHO) reported 306 291 cases in 2023, compared to 171 156 cases in 2022, representing an increase of 79%.[1] Since February 23, 2024, the African Union has recorded 10.271 new cases and 432 new deaths in nine countries, including Burundi, the Central African Republic (CAR), Congo, the Democratic Republic of Congo (DRC), Liberia, Mali, Senegal, Somalia, and Uganda.[3]

Measles can cause severe complications, especially during pregnancy, where it exposes both the mother and fetus to serious outcomes such as an increased risk of spontaneous miscarriage, preterm delivery, intra-uterine fetal death, neonatal death, and a high risk of subacute sclerosing panencephalitis in surviving newborns.[4–6] For herd immunity, the WHO recommends an immunization coverage rate above 95%.[1,2,7] As an immunizing disease, an immune pregnant woman transmits anti-measles antibodies to her fetus. Infants born to mothers who have previously acquired the disease or have been properly vaccinated benefit from the transplacental transfer of measles-specific immunoglobulin G (IgG), which generally protects them from infection during the first six months of life.[8,9] In Gabon in 2022, a measles outbreak was documented, and several cases occurred during pregnancy.[10]

To contribute to improving the health of newborns and, by extension, that of children against measles in our context, we conducted this study, the main objective of which is to assess the seroprevalence of measles antibodies in mother-child pairs in Libreville.

Patients and methods

This is an observational, prospective, multicentre, cross-sectional and analytical study that took place over a period of six months (1 October 2024 to 1 March 2025) in the delivery rooms of five healthcare facilities in the capital city of Libreville (four University Hospital Centres (CHU) and one Melen Regional Hospital Centre (CHRM)). The target population consisted of women in their third trimester of pregnancy admitted to the delivery room and their newborns.

We included mother-child pairs in the delivery room after obtaining informed consent, regardless of the mother's measles vaccination status. We did not include women in labour who had experienced foetal death in utero, who had a serious condition in the delivery room (haemorrhage, pre-eclampsia, etc.), who were known to be immunocompromised, or who did not give their consent. We excluded women in labour who had a stillbirth, who withdrew their consent, or who died before giving birth.

Sampling was non-probabilistic and exhaustive. It was based on the recruitment of all women in labour and their newborns in the delivery room who had given their consent by signing an informed consent form.

In terms of the variables studied, the dependent variable was the IgG antibody level ≥ 200 mIU/ml. The independent variables were divided according to data on the mother and the newborn.

For the mother: Age, occupation, history of measles vaccination, history of measles, number of confirmed pregnancies, parity and IgG antibody levels.

For the newborn: Gestational age, birth weight, sex and IgG levels.

Measles-specific IgG antibody levels were classified into two categories according to the instructions for the "SERION ELISA classic measles virus IgG", kit used in our study: a level < 200 mIU/ml indicated insufficient immunity and ≥ 200 mIU/ml indicated sufficient immunity. These limits have also been used in other studies.[11]

The study was conducted in four stages. After obtaining informed consent from the mothers, data were collected on a pre-established standardized form using information from the partograph and a detailed interview. Venous blood samples were collected (3 mL of maternal venous blood and 3 mL of cord blood from the newborn). Samples were transported to the CHUMEFJE laboratory within 24 hours, following appropriate packaging and transport conditions. Samples originating from the four other centers were placed in a cooler containing ice. Dry tubes were centrifuged using a Rotofix 32 a Hettich centrifuge, and 500 µL of serum were stored in a freezer at -30°C. The measurement of anti-measles IgG antibodies was performed using the SERION ELISA classic measles virus IgG kit. The procedure was conducted according to the manufacturer's instructions.

Statistical analysis

Data entry and analysis were performed using Excel 2016, R.[R] version 4.4.1, and Prism[R] version 6. Quantitative variables were expressed as mean and standard deviation or as median values. Qualitative variables were described as frequencies and percentages. To compare them, we used the Chi-square test. To assess the association between two events, we used the Odds ratio, and Spearman's correlation test (r) was used to evaluate the relationship between two quantitative variables. The significance threshold retained for all tests was a *p*-value less than 0.05 (5%).

Ethical and regulatory aspects

We obtained:

(i) Approval from the Scientific Council of CHUMEFJE under number **31/MSAC/CHUMEFJE/DG/DAM/CS;**

(ii) Approval from the National Research Ethics Committee (CNERS), number **0005/2024/CNERS**, dated May 28, 2024;

(iii) Authorization to recruit participants within the different health facilities;

(iv) Informed consent from the mother;

(v) Assent consent provided by the mother.

Results

During the study period, 92 mother–infant pairs were recorded, corresponding to 184 samples.

Maternal anti-measles IgG antibody levels

Measles-specific IgG antibodies were detected in 82.60% (n = 76) of pregnant women and were absent in 17.40% (n = 16). The mean antibody level was 366.68 mIU/ml (range: 3.10-1173.73 mIU/ml).

Neonatal anti-measles IgG antibody levels

Anti-measles IgG antibodies were present in 76.10% of newborns (70/92). Among these, 10.10% (n = 7) were preterm. The mean neonatal IgG level was 349.18 mIU/ml (range: 3.30-754.46 mIU/ml).

Among newborns with IgG levels <150 mIU/ml, preterm infants accounted for 15.8% (n = 3), with gestational ages between 30 and 36 WA. There was no association between neonatal anti-measles IgG levels and newborn-specific variables. However, there was a significant association between neonatal IgG levels and maternal age ($p = 0.04$). No association was found with other maternal variables. Table 1 presents the relationship between neonatal IgG levels, maternal age, and newborn characteristics.

Table 1 Association between anti-measles IgG levels, maternal age, and neonatal characteristics

Parameters		IgG < 200 (Non-immune/ Insufficient immunity)	IgG ≥ 200 (Immune)	p (Chi² test/ Chi² trend test)
	N = 92	N = 22	N = 70	
Gestational age				**0.40 / NA**
< 37 weeks	11 (12.00%)	4 (18.20%)	7 (10.00%)	
≥ 37 weeks	81 (88.00%)	18(81.80%)	63 (90.00%)	
Birth weight				**0.04 / 0.16**
< 2500 g	12 (13.00%)	8(36.40%)	4 (5.70%)	
2500-3999 g	75 (82.00%)	12(54.50%)	63 (90.00%)	
≥ 4000 g	5 (5.00%)	2(9.10%)	3 (4.30%)	
Sex				**0.98 / NA**
Female	42 (46.00%)	10(45.50%)	32 (45.70%)	
Male	50 (54.00%)	12(54.50%)	38 (54.30%)	
Maternal age				**0.04 / 0.03**
< 20 years	10 (11.00%)	3 (13.70%)	7 (10.00%)	
20–30 years	54 (59.00%)	17 (77.30%)	37 (52.90%)	
> 30 years	28 (30.00%)	2 (9.00%)	26 (37.10%)	

The mean neonatal IgG level in infants born to vaccinated mothers was 351.70 ± 204.60 mIU/ml, compared with 213.60 ± 174.30 mIU/ml for infants of unvaccinated mothers, and 359.20 ± 188 mIU/ml for infants of mothers with unknown vaccination status. No statistically significant difference was observed ($p = 0.233$).

Maternal characteristics

The median age was 25.50 years, with a Q1 of 23 years, a Q3 of 33 years, and extremes ranging from 17 to 44 years. The median number of pregnancies was 1 (Q1 = 0, Q3 = 2) with extremes ranging from 1 to 10. The median parity was 1 (Q1 = 0, Q3 = 2) with extremes ranging from 0 to 8. Table 2 presents the maternal characteristics.

Table 2 Maternal characteristics and anti-measles IgG levels

Parameters		IgG < 200 (Non-immune/ Insufficient immunity)	IgG ≥ 200 (Immune)	p (Chi² test/ Chi² trend test)
	N = 92	N = 16	N = 76	
Maternal age				**0.20 / 0.16**
< 20 years	10 (11.00%)	2 (12.50%)	8 (10.50%)	
20-30 years	54 (59.00%)	12 (75.00%)	42 (55.30%)	
> 30 years	28 (30.00%)	2 (12.50%)	26 (34.20%)	
Parity				**0.59 / 0.65**
Grand multiparous	4 (4.30%)	0 (0.00%)	4 (5.30%)	
Multiparous	12 (13.10%)	2 (12.50%)	10 (10.50%)	
Nulliparous	34 (37.00%)	7 (43.70%)	27 (35.50%)	
Pauciparous	19 (20.60%)	4 (25.00%)	17 (22,40%)	
Primiparous	23 (25.00%)	3 (18.80%)	20 (26.30%)	
Number of confirmed pregnancies				**0.55 / 0.43**
Large multigestation	14 (15.00%)	1 (6.25%)	13 (17.10%)	
Multigestation	18 (20.00%)	4 (25.00%)	14 (18.40%)	
Small gestation	35 (38.00%)	5 (31.25%)	30 (39.50%)	
Primigestation	25 (27.00%)	6 (37.50%)	19 (25.00%)	
Number of antenatal visits				**0.24 / NA**
< 4 ANC visits	7 (8.00%)	2 (12.50%)	5 (6.60%)	
≥ 4 ANC visits	85 (92.00%)	14 (87.50%)	71 (93.40%)	
Vaccination status				**0.40 / 0.80**
Unknown	63 (67.50%)	10 (62.50%)	53 (69.70%)	
Unvaccinated	5 (5.30%)	2 (12.50%)	3 (4.00%)	
Vaccinated	24 (26.10%)	4 (25.00%)	20 (26.30%)	
History of measles				**0.73 / 0.60**
Unknown	59 (64.00%)	9 (56.30%)	50 (65.80%)	
No history	22 (24.00%)	5 (31.20%)	17 (22.40%)	
Previous measles	11 (12.00%)	2 (12.50%)	9 (11.80%)	

In 68.50% (n=63) of cases, vaccination status was unknown. In 64.10% (n=59) of cases, the women in labour were not aware that they had measles as children.

Neonatal characteristics

The median gestational age was 39 weeks of amenorrhea (WA) (Q1 = 37.80 WA, Q3 = 40 WA), with extremes ranging from 30 to 42 WA. Newborns with gestational age ≥ 37 WA represented 88% (n = 81).

The median birth weight was 3100 g (Q1 = 2656 g, Q3 = 3325 g), with extremes from 1700 g to 4200 g. The sex ratio was 1.19.

Correlation between maternal and neonatal anti-measles IgG levels

A strong and significant positive correlation was observed between maternal and neonatal anti-measles IgG levels (r = 0.87; $p < 0.0001$) (Figure 1).

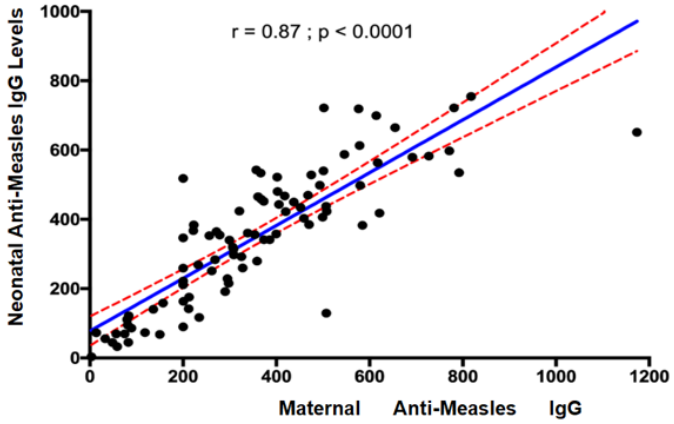

Figure 1 Correlation between maternal anti-measles IgG levels and neonatal anti-measles IgG levels.

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The vertical transmission rate of maternal anti-measles IgG to the newborn was 92.10% [(70/76) × 100].

A newborn from an immunized mother had 358 times higher odds of benefiting from passive measles immunity ($p < 0.0001$; Odds ratio: 358).

Discussion

The limitations of the study

The challenges encountered in carrying out this study included the small number of samples analyzed due to logistical constraints (a shortage of reagents in Gabon), the lack of information regarding the mothers' measles vaccination status and measles history, which depended on their recollection and the absence of health records to verify the accuracy of the information provided. Many participants did not know whether they had previously contracted measles or received vaccination. Consequently, it was not possible to determine whether the presence and level of anti-measles antibodies were due to vaccination or natural exposure to the wild virus.

Seroprevalence of maternal anti-measles IgG

A seropositivity rate of 82.60% for anti-measles IgG (> 200 mIU/ml) was found among the mothers. This rate is higher than that reported by Karaayvaz et al. in Turkey in 2019 (72.50%).[12] It is similar to the findings of Lu et al. in 2016 (81.60%)[13] and Fu et al. in 2016 (81.60%),[14] and to the 87.40% rate reported by Barmpakou et al. in 2023.[11]

However, it is lower than the rates reported by Diaz-Ortega et al. in Mexico in 2020 (99.37%)[15] and Muthiah et al. in 2021 (91.50%).[16]

While the populations in Diaz-Ortega's and Muthiah's studies surpassed the WHO recommended 95% immunity threshold required for herd immunity, most of the other studies cited including ours, fall below this threshold. This is likely due to insufficient or inadequate vaccination coverage, which has declined in many countries (59 out of 194).[17]

The effectiveness of measles vaccination is well established; it remains the only means to protect against and eradicate the disease. This underlies the ambitious measles elimination initiative launched by the WHO in 1997.[18]

Vaccine resistance and the absence of booster doses are the most frequently cited factors contributing to the resurgence of measles worldwide.[17]

Leong et al. demonstrated that the main driver of measles resurgence in Europe is not human migration but insufficient vaccination, especially when coverage for the second dose is below 84%.[7] Even among individuals who were correctly vaccinated, immunity declines over time due to the absence of circulating wild virus and the interval between the first and second vaccine doses.[19–21] This presents a real concern for women of childbearing age and, consequently, for the seroprotection of their newborns.

It is well established that the quality of antibodies transferred to the infant depends closely on the mother's immunological history, as she transmits her own antibody repertoire.[22] In pregnant women, lack of immunity poses a major risk for the newborn, particularly in contexts such as ours, where measles circulates epidemically. In Gabon, the first dose of the measles vaccine is administered at 9 months of age. It is therefore concerning that, in our study and in several others, more than one-quarter of pregnant women did not have protective IgG levels against measles.[11–14] Even when effectively transferred, the persistence of anti-measles IgG in infants depends on the initial concentration received. Lu et al. reported a rapid decline in transferred antibodies from 3 months of age and a complete drop by 7 months among infants with low or moderate initial levels, although those with high initial titers remained significantly positive at 5 months.[13]

Seroprevalence of neonatal anti-measles IgG and its relationship with maternal antibody levels

In our study, 76.10% of newborns had protective anti-measles IgG levels (> 200 mIU/ml). This is lower than the rates reported by Lu et al. (87.30%),[13] Fu et al. (87.30%),[14] Barmpakou et al. (89.30%),[11] and Muthiah et al. (95%).[16]

These neonatal IgG rates are strongly correlated with maternal IgG levels. In our work, regardless of maternal age, we observed a strong association between neonatal and maternal anti-measles IgG ($r = 0.87$; $p < 0.0001$). A newborn of an immunized mother had 358 times greater odds of acquiring passive measles immunity. These findings are consistent with those of Fu et al. in China ($p < 0.001$),[14] Lu et al. in China ($r = 0.917$; $p < 0.001$),[13] Khampanisong et al. in Laos ($p < 0.010$),[21] Muthiah et al. ($p < 0.0001$),[16] and Barmpakou et al. in Greece ($r = 0.924$; $p = 0.001$).[11]

Thus, when a mother is immunized against measles and has adequate IgG levels, she transmits them efficiently to her newborn. The only way to ensure this protection is through proper immunization of women. In Gabon, epidemic circulation of the virus may reinforce immunity within the population. Indeed, infants born to mothers with natural immunity acquired through infection are less susceptible to measles than infants of vaccinated mothers, due to higher IgG titers in the former.[23]

Nevertheless, prevention remains the most effective strategy: vaccination of the general population and of women remains essential, even though it does not always guarantee long-term immunity, regardless of whether one or two doses are administered.[2,24]

In Gabon in 2023, coverage for the first dose of the measles vaccine at 9 months of age was 66%, far below the target of 90%, leaving many children unprotected. This low coverage is the primary driver of measles outbreaks in the country, where 1293 confirmed cases were reported in 2022.[25] These low childhood vaccination rates foreshadow inadequate immunity later in life, particularly for future mothers. This supports recommendations from several authors and programs advocating measles vaccination for women of childbearing age prior to pregnancy, to increase antibody levels and enhance passive immunity transfer to newborns.[4,26,27]

Conclusion

We found a non-negligible proportion of mothers and newborns with insufficient levels of anti-measles IgG antibodies. We also observed a strong correlation between maternal and neonatal anti-measles IgG levels. These findings highlight that immunizing woman of childbearing age is essential to ensuring robust immune protection for newborns. Therefore, advocacy for measles vaccination in this population group is necessary in our country.

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Conflicts of interest

The authors declare that they have no competing interests.

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