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Research Article

Seroprevalence of Measles Immunoglobulin G (IgG) Antibodies in Children Aged 9-59 Months at the University Hospital Centre for Mothers and Children (CHU-ME) of N'Djamena

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Abstract

Introduction: Measles is a highly contagious viral disease caused by a Morbillivirus. It is transmitted by air (respiratory droplets). It is one of the main causes of infant mortality in regions where vaccination is inadequate. Prevention relies mainly on vaccination, which is effective in reducing the spread and impact of the disease. The aim of this study was to assess the level of measles immunity in children aged 9 to 59 months at the CHU-ME in N'Djamena. **Material and Methods:** This was a prospective, analytical study conducted over a four-month period from June to September 2024. To measure the seroprevalence of IgG measles antibodies in children, the ELISA (Enzyme-Linked Immunosorbent Assay) technique was used. This method is renowned for its high sensitivity and specificity, enabling precise detection of antibody levels in the blood. Of the 162 samples analyzed, 67 were female and 95 male. The majority came for malaria, influenza and diarrhoea. **Results:** The prevalence of children immunized against measles was 73.46% (IgG positive). Differences by age group revealed that children aged 48-59 months had a higher seroprevalence than children in other age groups. Children who received two doses of vaccine developed a higher immunity rate of 65.54%, while those who received one dose of vaccine developed 34.45% immunity, with a significant difference between vaccine doses. **Conclusion:** Epidemiological factors, such as malnutrition and origin, also influence seroprevalence, with higher prevalence in urban areas. Weight also has an impact, with greater immunity in children weighing between 5 and 13.7 kg. These results offer clues for strengthening vaccination and measles epidemic prevention strategies.

Keywords: Measles, children, antibodies, anti-measles.

Introduction

Measles is a viral infectious disease caused by a Morbilivirus. It is a highly contagious viral disease (KABORE, 2019). It can lead to serious complications and even death, particularly in infants, adults and immunocompromised individuals [1]. Measles generally manifests as high fever, runny nose, cough, sore throat and conjunctivitis (red eyes), followed by a rash that spreads all over the body [2]. The virus is transmitted by air. Before the introduction of measles vaccines, major epidemics were recorded, causing around 2.6 million deaths each year. Although a safe, effective and inexpensive vaccine is available worldwide, in 2019 the World Health Organization (WHO) reported a significant increase in measles cases worldwide, the highest figure in over two decades. From January to April 2019, 112,163 cases were reported in 170 countries, an increase of 300% on the same period in 2018 of 28124 [3].

The increase in cases was particularly alarming, with an estimated 200,000 deaths, an increase of 50% since 2016 [4]. Measles occurs in many countries around the world. It mainly affects regions beset by conflict and instability, with major population displacements, where vaccination campaigns are interrupted. In addition, some forty countries have postponed their measles vaccination campaigns for 2020 or 2021 due to the COVID-19 pandemic. According to the WHO, in 2020, over 22 million infants did not receive their first dose of measles vaccine, 3 million more than in 2019. Between April 2021 and April 2022, 21 major measles outbreaks were recorded [5].

Measles is an epidemic in Africa. According to the WHO, some 17,500 cases of measles were reported in the African region between January and March 2022, representing a 40% increase over 2021 [6]. In Africa, the countries reporting several thousand cases of measles are mainly Chad, with 5,832 cases, including 79 deaths, and Nigeria, with 3,804 cases, including 26 deaths.

To counter this disease, the government of Chad, in collaboration with its partners, notably the WHO, launched an emergency vaccination campaign to contain the spread. More than 1.5 million children were vaccinated in the worst-affected provinces (Chari-Baguirmi, Mandoul, Mayo-Kebbi Est and Sila) [6].

Despite the efforts made through the introduction of measles vaccination, measles remains a major public health concern, particularly among children. With this in mind, we set out to determine the measles antibody profile in children aged 9 to 59 months at the Centre Hospitalier Universitaire de la Mère et de l'Enfant (CHU-ME) in N'Djaména.

Methods

Type and Location of Study

This study was carried out to evaluate the profile of anti-measles antibodies (IgG) in children aged 9 to 59 months. The study was carried out at the Centre Hospitalier Universitaire de la Mère et de l'Enfant (CHU-ME), more precisely in the pediatrics department and in the laboratory. It was a prospective study with an analytical aim that took place over a period of four (4) months, from June to September 2024.

Study Population

The study covered children aged 9 to 59 months of both sexes who had received measles vaccine and who had visited the CHU-ME pediatric ward during the study period.

Blood Collection

Blood was collected by puncture of a peripheral vein on a dry tube for IgG assay. The variables were sociodemographic, biological and clinical.

The Elisa Technique

ELISA (Enzyme-Linked Immunosorbent Assay) is a highly sensitive analytical technique used to detect and quantify specific biomolecules, such as antibodies and antigens, through their interaction.

Operating Mode

✓ Remove plate and leave at room temperature for at least 30 minutes before use.

✓ Homogenize all reagents with the vortex.

✓ Prepare wash solution at 1/20th to ensure dissolution of crystals with distilled water,

✓ Use the pre-coated measles virus antibody ELISA plate supplied with the SERION ELISA kit.

✓ Place on a rack by order (code number) before analysis.

✓ Prepare samples by adding 10µL to the working solution (buffer: 1000µL).

✓ Reserve wells A1, B1, C1, D1 for the positive and negative controls, as well A1 is reserved for the internal control.

✓ Place 100µL of negative control in wells A1 and B1 and 100µL of positive control in wells C1 and D1 and well E, reserved for internal control;

✓ Dispense 100µL of sample into each corresponding well,

✓ Incubate for 60 minutes at 37°C in the dark.

✓ Wash and aspirate wells 5 times with wash solution to avoid residues.

✓ Dispense 100µL of APC conjugate into each well;

✓ Incubate for 30 minutes at 37°C.

✓ Wash and aspirate 4 times with wash solution;

✓ Add 100µL of PNPP substrate to each corresponding well,

✓ Incubate for 30 minutes at 37°C,

✓ Apply 100µL of STOP solution to all wells;

✓ Read the plates in an Elisa reader at 450 nm.

✓ Analyze results in software.

Interpretation of Results

✓ All results with values : ≥ o.47

✓ Consider as negative all results with values < 0.4

Statistical Analysis

Data were collected from a questionnaire (survey form). Version Microsoft Excel 2016 software was used for data entry. SPSS software was used for data analysis. The Chi2 test was used to compare percentages with a significance level of $P < 0.05$.

Ethical Considerations

The survey was carried out with the informed written consent of the children's parents.

The anonymity of the surveys and the confidentiality of the information obtained were guaranteed.

Results

In our study on the "Seroprevalence of measles immunoglobulin G (IgG) antibodies in children aged 9 to 59 months at the Centre Hospitalier Universitaire de la Mère et de l'Enfant (CHU-ME) in N'Djamena", a total of 162 samples were analyzed. These samples were divided into two distinct groups, namely 67 girls and 95 boys, representing respectively 41.36% and 58.64% of the total population studied. The main objective of this section is to present and analyze the results obtained from measles-specific immunoglobulin G (IgG) tests, thereby providing a better understanding of the level of immunity to this disease in the child population attending the CHU-ME during the study period.

❖ **Sociodemographic, biological and clinical characteristics of study participants.**

- **Frequency of study results**

The figure below shows the overall frequency of measles antibody seroprevalence investigated during our study period. Of the 162 (100%) samples examined in our study, 119 (73.46%) were positive and 43 (26.54%) were negative.

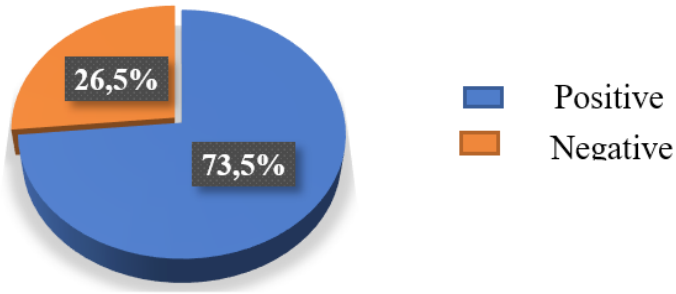

Figure 1: Study statistics.

Prevalence of measles IgG positive cases by age, sex, vaccine doses, height and weight of children.

This table analyzes the prevalence of positive cases according to age, sex, number of vaccine doses, height and weight of children. Prevalence remains similar across age groups (around 33-35%), but the 36-47 months age group shows a statistically significant difference with a p-value of 0.009. Girls show a higher prevalence (85.07%) than boys (65.26%), but without statistical significance. With regard to doses, the results were that 34.45% developed immunity, compared with 65.54% with a significant P-value. For height, there was no significant difference between children measuring more or less than 93 cm. Finally, weight showed a significant difference between children weighing between 5 and 13.7 kg (p-value 0.027), suggesting that weight in this category could influence the prevalence of positive cases.

Parameters	Terms and conditions	Eff. (n)	Prevalence (%)	Chi-square	IC à 95%	p-value
	Sep-23	53	44,53	0,022	0,212 - 1,171	-
Age(months)	24-35	28	23,52	0,033	0,314 – 1,438	0,134
	36- 47	15	12,60	0,020	0,2241 –,802	**0,009**
	48- 59	23	19,32	–		–
Sex	Male	62	52,10	0,313	2,588 – 3,092	0,06
		57	47,9	0,180	0,059 -- 0,215	0,132
Dose	Dose 1	41	34,45	0,562	2,412 – 1,068	**0,04**
	Dose 2	78	65 ,54	0,710	0,056-0,41	**0,002**
	68 à 93cm	77	64,70	-	-	-
Weight	≤ 4,5 Kg	12	10,08	-	-	-
	5 à 13,7 Kg	58	48,74	**0,559**	2,390 – 2,893	**0,027**
	≥ 13,7 Kg	49	41,17	0,461	0,078 – 0,126	0,320

Table 1: Prevalence of measles IgG positive cases according to age, sex, vaccine doses, height and weight of children.

- **Distribution of positive cases by patient origin (urban & rural) and age group**

In all age groups, the majority of positive cases come from urban areas, with particularly marked differences in the 24-35 months and 36-47 months age groups. However, p-values show that these differences are not statistically significant, except for the 36-47 months and 48-59 months age groups, where significance is close.

Variables Positive	Patients' origin				p-value
Age(months)	Urban		Rural		
	Eff. (n)	%	Eff. (n)	%	
9-23	42	44,68	11	44,0	0,256
24-35	22	23,40	6	24,0	0,256
36-47	12	12,76	3	12,0	0,082
48-59	18	19,14	5	20,0	0,083

Table 2: Distribution of positive cases by patient origin (urban & rural) and age group.

- **Distribution of study population by reason for consultation.**

The table reveals notable differences in measles antibody positivity by sex and reason for consultation, showing a predominance of consultations for various reasons (such as malaria, influenza or diarrhoea), representing 70.96% of boys and 87.72% of girls. Malnutrition and sickle cell disease were less frequent, especially among girls. It should also be noted that HIV infection was mentioned only among boys in this study, although this is a limited sample.

Reason for consultation	Variables				Total %
	Boys	%	Female	%	
Malnutrition	8	12,90	5	8,77	10,92
Sickle cell disease	5	8,06	2	3 ,50	5 ,88
HIVinfection	5	8,06	0	0 ,00	4 ,20
Other (malaria, flu, diarrhea, etc.)	44	70,96	50	87,72	79,00

Total	62	100	57	100	19

Table 3: Distribution of study population by reason for consultation.

Discussion

Our study investigated the seroprevalence of measles IgG antibodies, 162 samples were analyzed, 119 (73.46%) were positive for measles immunoglobulin G (IgG) antibodies, indicating that these individuals had developed an immune response following vaccination. However, 43 samples (26.54%) remained negative, which could indicate incomplete immunization, due to factors such as age at vaccination, malnutrition, or vaccine inefficiency caused by errors in vaccine management or storage. Our results are similar to those obtained in Nigeria by Ogbuanu et al. [7], where a rate of 70% was observed. However, they are lower than those obtained by McMorrow et al. [8] in South Africa, with 85% of positive results. This difference could be explained by a better health infrastructure and better access to care in this area.

Analysis of the distribution of measles IgG antibodies by age group and sex in our experiments revealed significant disparities. For age groups ranging from 9 to 47 months, no significant difference was observed between boys and girls ($p > 0.05$). This indicates that the immune response to measles vaccination is similar for both sexes at this age interval. However, the 48-59 months age group showed a slight dominance, with higher seroprevalence in boys. This could be explained by biological differences in the maturation of the immune system, or by environmental factors influencing the vaccine response. Our results are in line with those found by Ouédraogo et al, [9] in Burkina Faso and Issaka et al, [10] in Niger, who showed no gender difference in younger children, but differences in children over 3 years of age, with a better immune response in male children.

With regard to the number of doses of vaccine, our results show a significant difference in terms of immune response between children who received one or two doses of measles vaccine, depending on their age. For children who received a single dose, only 34.45% developed immunity to measles, while for those who received two doses of vaccine, overall seroprevalence rose to 65.54%, with a more even distribution between age groups, underlining the importance of complete administration of doses to ensure robust immunity. These results confirm the efficacy of the second dose of measles vaccine, especially in the older age groups. Our results are in line with those obtained by Issaka et al. [11], which showed a seroprevalence of around 35% after one dose versus 70% after two doses, and showed that the administration of a single dose of vaccine is insufficient to guarantee lasting immunity, and those obtained by wanjala et al, [12] in Kenya and slightly lower than the results found by Nalwoga et al. [13] in Uganda, where seroprevalence rose from 45% among children who received one dose to 80% after the second dose. This difference could be explained by differences in vaccination coverage or access to quality healthcare, which can influence the immune response to the vaccine.

The results of our experiment show a prevalence of measles IgG antibodies that varies with the weight of the children in the different age groups, although these variations are not significant ($p > 0.05$). Specifically, children weighing between 5 and 13.7 kg and those weighing ≥ 13.7 kg had higher levels of positive antibodies. This result could be explained by good health in these weight ranges. This is similar to the results obtained by Ouédraogo et al. [14] in Burkina Faso and Issaka et al. [10] in Niger. In their study, they found that seroprevalence in children weighing more than 10 kg was higher than in children weighing less than 10 kg. This disparity underlines the importance of good nutrition, particularly after vaccination.

Our experience shows that 89.3% of positive cases come from urban areas, compared with 10.7% of children from rural areas. Our results are slightly higher than those found by Ouédraogo et al. [9] in Burkina Faso, with a prevalence of 75% in urban areas. This difference could be explained by a difference in health system and vaccination coverage, but also by the representativeness of vaccinated children in urban areas.

Conclusion

This study of measles IgG antibody seroprevalence in children aged 9-59 months revealed that 73.46% of participants were immunized, with overall satisfactory vaccination coverage. Girls showed a higher seroprevalence (85.1%) than boys (65.3%), although without statistical significance. The majority of children who received two doses of vaccine (73.58%) developed immunity, confirming the importance of full vaccination.

However, a significant percentage of vaccinated children did not develop measles-antibody (26.54%), which could be due to a number of factors, including immune system immaturity and comorbidity (HIV, malnutrition, etc.).

The study highlights the need to step up awareness-raising to improve vaccination coverage, especially in rural areas and for at-risk children, particularly those suffering from malnutrition or chronic illnesses.

Conflicts of interest: The authors declare no conflicts of interest.

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