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Epidemiological study of the occurrence of measles in children aged 0-15 years in the Banalia Health Zone (DR Congo) during 2022

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Abstract

Introduction: In 2021, the Banalia Health Zone experienced two measles epidemics with a vaccine completeness rate of 69% according to data provided by the Tshopo Provincial Health Division. The aim of the study was to list the epidemiological characteristics of measles cases in the Banalia Health Zone, to determine the incidence of measles in children aged 0-15 years, and to analyze the vaccination status of children with measles.

Methodology: This was a retrospective descriptive study, based on the acquisition of data from the medical records of the targeted children or from data registers at the time of submission. A total of 3,968 children with measles were selected from the various health centers and areas of the Banalia Health Zone.

Results: We observed that 64.6% of the subjects in the study were aged between 0 and 5 years; 40.77% of measles cases were recorded in September 2022. The measles vaccination rate was 39.19% and the case fatality rate was 2.8%. The Panga 2 axis had the highest number of measles cases, with a prevalence rate of 29.03%.

Conclusion: Measles is a major cause of morbidity and mortality in the Banalia Health Zone. The age group most affected is 0-5 years. Vaccination and surveillance systems need to be strengthened to reduce the growing risk posed by measles.

Keywords: Epidemiological; Study; Occurrence; Measles; Children; Health Zone.

1. Introduction

Measles is a highly contagious viral disease that mainly affects children. The viruses are spread when sufferers cough or sneeze, or by direct contact with nasal or laryngeal secretions. It is caused by a virus of the *Paramyxoviridae* family. Measles remains one of the leading causes of death in young children, despite the existence of a safe and effective vaccine. An estimated 89,780 people, the majority of them children under the age of five, died from measles in 2016 [1, 2].

Measles, a highly contagious viral disease, is one of the biggest killers of children in most Third World countries. In 2015, measles killed 134,200 children under the age of 5 worldwide, i.e. 350 to 400 children a day. This disease therefore remains one of the major causes of mortality in young children - after respiratory infections, diarrheal diseases, malaria and meningoencephalitis - despite a considerable increase in vaccination, of 18% between 2000 and 2015 [3].

Since 2017, after a downward trend (from 585,701 cases in 2005 to 132,328 cases in 2016, i.e. a drop of 75%), there has been an increase in cases which is continuing in 2019, particularly in the regions of Europe and America. In 2018, the total number of cases reported to the WHO worldwide exceeded 300,000. Epidemic outbreaks were observed,

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particularly in the Americas, in Brazil (10,326 cases), Venezuela (5,643 cases), the United States (372 cases), Ukraine (53,218 cases), France (2,953 cases) and Italy (2,953 cases) [4].

The measles epidemic claimed 140,000 lives in 2018, 15% more than in 2017. As the disease affects the immune systems of infants and young children, measles has mainly wreaked havoc on children under the age of five, according to a report by the WHO and the US Centers for Disease Control and Prevention. This alarming resurgence is confirmed by the fact that three times as many cases of measles were reported worldwide in the first quarter of 2019 compared with 2018 [5].

According to the World Health Organization report, most measles victims were children under the age of five. Infants and young children are the most vulnerable to infection by the virus. This report shows that the worst consequences of measles have been seen in sub-Saharan Africa, where many children have been deprived of vaccination. But wealthier countries are not spared from measles outbreaks either. The United States has reported the highest number of cases in 25 years, while Albania, Czechoslovakia, Greece and the United Kingdom lost their measles elimination status in 2018 following cases of infection lasting more than a year without interruption on their territory [6].

In Africa, the countries most affected by the measles epidemic in 2018 include the Democratic Republic of Congo, Liberia, Madagascar and Somalia. These countries account for almost half of all measles cases worldwide. In Ethiopia, more than 12,000 cases of measles have been reported in 5 regions of the country. The Oromia region has been the most affected, followed by the Somali region [7].

In the Central African Republic, health authorities are also reporting an upsurge in measles. In the first 6 weeks of 2020, 1,498 clinical cases of measles were reported, including 15 deaths. Since the start of 2019, a total of 5,724 clinical cases of measles, including 83 deaths, have been reported in this country [8].

In Chad, 1,276 clinical cases have been reported since the beginning of the year. The measles epidemic has been ongoing since 2018. In 2019, a total of 26,623 clinical cases of measles, including 259 deaths, have been reported in 36 districts. Travel can increase the risk of exposure to the measles virus as well as its spread to susceptible unvaccinated populations (including infants) [9].

In the Democratic Republic of Congo (DRC), Médecins Sans Frontières (MSF) is warning of the worst measles epidemic in the world. More than 310,000 people have been infected and 6,000 have died in the last year. Three quarters of deaths have been among children. The epidemic has affected every province in the country [10].

Measles is on the rise in the Democratic Republic of Congo: the disease has claimed more than 5,000 lives since January 2019, according to figures announced on Wednesday 27 November by the World Health Organization (WHO). Yet the measles epidemic in the DRC has attracted far less attention than the Ebola epidemic that has been raging in the east of the country since August 2018, claiming some 2,200 lives. The outbreak in the DRC is the largest in the world. As of 17 November 2019, 250,270 cases had been recorded in the DRC, with 5,110 deaths [11].

According to the DPS/Tshopo Report, 2020, Tshopo Province has not been spared. From January to March 2021, it recorded 14,829 cases, including 471 deaths, with the Yabaondo Health Zone leading the way with 4.9% of cases and deaths, followed by the Yahuma Health Zone with 2.5% of cases. This situation justifies the repetition of the vaccination campaign against this disease.

A measles epidemic has spread to several regions of the Democratic Republic of Congo, including Kisangani, the capital of Tshopo province. In the first five months of 2019, according to Médecins Sans Frontières, more than 1,500 measles-related deaths have been recorded.

The Covid-19 health crisis led to major delays in measles vaccination campaigns, destabilizing vaccination coverage worldwide and putting millions of children at risk. As a direct consequence, the number of reported cases has risen dramatically. The UN and WHO fear that this delay will be exacerbated by a rapid lifting of health measures, and that this measles outbreak will also contribute to a resurgence of epidemics.

While the Democratic Republic of Congo is still facing measles epidemics, the authorities are stepping up their efforts to vaccinate and protect children. This highly contagious viral disease mainly affects children. The virus is spread when sufferers cough or sneeze, or by direct contact with nasal or laryngeal secretions.

The aim of this study is to improve the health of children with measles by raising parents' awareness of measles vaccination in the Banalia Health Zone.

Specifically, the study aims to list the epidemiological characteristics of measles cases in the Banalia Health Zone, determine the incidence of measles in children aged 0 to 15, and analyze the vaccination status of children with measles.

2. Methodology

2.1. Brief description of the research area

The study was conducted in the Banalia Health Zone, which is located in the Territory of Banalia, 128 km north of the city of Kisangani, in the Province of Tshopo in the Democratic Republic of Congo. It serves a total population of 172,137, with 5 communities. It has 20 health areas and a general referral hospital. It is divided into six supervisory areas, grouped as follows: the Banalia Centre area, which includes the Dr. Sharp, Sainte Elisabeth, Bethlehem and St. Mary's health areas. The Banalia Centre axis comprises the Dr Sharp, Sainte Elisabeth, Bethsaida and Lukelo health areas, the Panga 1 axis comprises the Alolo, Motoma and Mangala health areas, the Panga 2 axis comprises the Panga, Babise and Mosanda health areas, and the Buta 1 axis comprises the Bopepe, Zambeke and Zambeke health areas: Bopepe, Zambeke, Dikwa and Kole; the Buta 2 axis, which includes the health areas of Mangi, Bongonza, Akuma and Tele; and the Mara axis, which includes the health areas of Bodela and Baloma.

2.2. Study population and sampling

The study population consisted of 3,968 children aged 0-15 years who presented with measles during the study period and were admitted to and treated in the various health areas of the Banalia Health Zone.

Given that the study population was finite, we thought it would be useful to work with an exhaustive sample, consisting of all the children affected by measles in this health zone under the supervision of the Ministry of Health.

2.3. Type of study

Our study is a retrospective cross-sectional descriptive study conducted in the Banalia Health Zone and covering the period from July 1 to December 31, 2022.

2.4. Data collection technique

As the study was retrospective, we used documentary analysis, which enabled us to consult various documents used in the management of children with measles, in particular consultation forms, care cardexes, laboratory vouchers, patient registers, etc. The data were collected by means of a questionnaire.

To achieve this, we drew up a data collection sheet that enabled us to gather the information relevant to our research. In drawing up this data collection form, we selected the following variables: sex, age group, epidemic period, vaccination status, mortality rate, case-fatality rate and source.

2.5. Data analysis and interpretation

To analyze and interpret the data, we first grouped them into different frequency tables, and then calculated percentages.

3. Results

3.1. Socio-demographic characteristics of study subjects

3.1.1. Age group

The table shows that 64.6% of the study subjects were in the 0-5 age group, followed by the 6-10 age group, which accounted for 31.6%, and 3.8% in the 11-15 age group.

Table 1 Age distribution of study subjects

Age groups (Year)	Effectives	%
0 – 5	2563	64.6
6 – 10	1253	31.6
11 – 15	152	3.8
Total	3968	100.0

3.1.2. Gender

The table shows that 51.69% of the study subjects were female, compared with 48.31% male.

Table 2 Gender distribution of study subjects

Gender	Effectives	%
Female	2051	51.69
Male	1917	48.31
Total	3968	100.0

3.2. Study period in months

The table shows that September 2022 recorded the highest number of measles cases (40.77%), followed by October (22.08%), November (22%), August (7.66%) and December (7.16%). A low rate was observed in July, with 0.33% of cases.

Table 3 Distribution of study subjects according to the month of the measles epidemic

Months	Effectives	%
July	13	0.33
August	304	7.66
September	1618	40.77
October	876	22.08
November	873	22.0
December	284	7.16
Total	3968	100.0

3.3. Vaccination status

This table shows that 39.19% of the subjects in the study had been vaccinated, and 32.99% had not. On the other hand, we observed that the vaccination status was unknown for 27.82% of the subjects in the study.

Table 4 Distribution of study subjects according to vaccination status

Vaccination status	Effectives	%
Vaccinated	1555	39.19
Unvaccinated	1309	32.99
No information	1104	27.82
Total	3968	100.0

3.4. Lethality due to measles

Table 5 Distribution of study subjects according to measles deaths

Number of cases	Number of deaths	%
3968	112	2.8

Analysis of this table shows that out of a total of 3,968 cases of measles recorded during the study period, deaths accounted for 112 cases, i.e. a case-fatality rate of 2.8%.

3.5. Deaths by age group

Table 6 Distribution of study subjects according to deaths by age group

Age groups (Year)	Effectives	%
0 – 5	74	66.07
6 – 10	34	30.36
11 – 15	4	3.57
Total	112	100.0

This table shows that 66.07% of measles deaths among the subjects studied occurred in the 0-5 age group, followed by the 6-10 age group (30.36%) and the 11-15 age group (3.57%).

3.6. Source

Table 7 Distribution of study subjects by place of origin

Provenance (Axis)	Effectives	%
Panga 2	1152	29.03
Buta 2	953	24.02
Panga 1	681	17.16
Buta 1	501	12.63
Mara Banalia Centre	395 286	9.95 7.21
Total	3968	100.0

The table shows that 29.03% of measles cases came from the Panga 2 axis, comprising the health areas of Panga, Babise and Mosanda; followed by 24.02% from the Buta 2 axis, comprising the health areas of Mangi, Bongonza, Akuma and Tele; then 17.16% from the Panga 1 axis, comprising the health areas of Alolo, Motoma and Mangala; 12.63% of the Buta 1 axis, which includes the Bopepe, Zambeke, Dikwa and Kole health areas; 9.95% of the Mara axis, which includes the Bodela and Baloma health areas; and finally the Banalia Centre axis, which includes the Dr. Sharp, Sainte Elisabeth, Bethlehem and Kole health areas. The Banalia Centre axis, which includes the Dr Sharp, Sainte Elisabeth, Bethsaïda and Lukelo health areas, recorded fewer cases (7.21%).

3.7. Effectiveness of routine vaccination (Vaccination coverage in routine VAR)

Analysis of this table shows that 84.58% of children aged 0-11 months had been vaccinated in VAR in September, ahead of October, which recorded 81.42% of cases, November, 80.83%, July (78.06%), December (77.27%) and August 2022, with 73.91% of cases.

Table 8 Vaccination coverage in VAR for children aged 0-11 months during the study period in months

Months	Target	Number of children vaccinated	%
July	506	395	78.06
August	506	374	73.91
September	506	428	84.58
October	506	412	81.42
November	506	409	80.83
December	506	391	77.27

4. Discussion

4.1. Socio-demographic characteristics of study subjects

Analysis of the proportion of measles cases by age group revealed that 64.60% of the subjects in the study were in the 0-5 age group.

The WHO report published states that thanks to a vaccine response campaign launched on Thursday 4 March 2021 by the health authorities in South-Ubangi (north-west DRC), more than 171,731 children aged between 6 and 59 months will be protected from measles, an epidemic that is rife in the Bwamanda, Gemena, Libenge and Ndage health zones. This campaign also includes more than 2,323 Central African children aged 0 to 4 at high risk of contracting measles in this province, which is home to more than 10,063 refugees from the Central African Republic (CAR), according to the latest data provided at the end of February 2021 by UNHCR in the DRC [12].

The same situation was described by Ibrahim Seck et al in Senegal [13], who found that 67.5% of measles cases recorded were under the age of 5. These results are supported by Seydou [14] who found 87.5% of children with measles in the 0-5 age group in Mali.

These results confirm the theory that measles mainly affects infants, and that in developing countries, it predilection is for children under 5 years of age.

In terms of gender, the study revealed that measles was more prevalent among female subjects (51.69%). Males were the least affected. This result is not far from that of Mukalay, Mushadi et al [15], who reported that 60% of measles cases recorded in 2021 were female, and that of Boushab et al from Mauritania [16], who found that 56% of cases were female in 2015.

It should be noted that both sexes can be affected by measles in the same way. There is therefore no indication anywhere that gender is a predilection factor for measles. This result therefore reflects chance. Measles outbreaks occur when people who have no immunity to the virus become infected and transmit the disease to unvaccinated or insufficiently vaccinated populations. To combat measles and prevent outbreaks and deaths, coverage rates for the first and second doses of the vaccine must reach 95% and be maintained at national and sub-national levels.

4.2. Epidemic period (in months)

The measles epidemic lasted from July to December 2022, with a peak in September (40.77% of cases).

Ibrahim Seck et al [13] observed the same situation in Senegal in 2012, where the measles epidemic began in June, declined in December and reached its peak in September, with 40% of cases, before falling back before the response was implemented.

The WHO has announced that there were three times as many cases of measles worldwide between January and July 2019 as in the same period in 2018. The Democratic Republic of Congo, Madagascar and Ukraine are particularly hard hit. Figures published by the World Health Organization [12] show that from 1 January to 31 July 2019, 364,808 cases were recorded, compared with 129,239 during the same period last year. These are the "highest" figures recorded since 2006.

However, it has been described that measles epidemics occur during the dry season and subside as soon as the first rains appear. This would suggest that measles epidemics occur during both the dry and rainy seasons. In reality, the seasonal nature of measles epidemics is more related to the loss of herd immunity in susceptible individuals.

4.3. Vaccination status

The results of this series show that 39.19% of the subjects in the study had been vaccinated against measles. This result is similar to that of Saydou [14], who found that 31.25% of children had been vaccinated against measles. On the other hand, Ibrahim Seck et al [13] found that 88.5% of cases in Senegal had contracted measles but had not been vaccinated against the disease.

The results of the study by Baonga et al [8] show that in no health area was the objective of 90% vaccine completeness achieved. The worst performance was found in the Etoa Meki health area (28.6%), a totally urban health area. The absence of a leading public health facility and the failure to implement the strategies put forward by the district in this area explain this poor performance.

The high rate of vaccination coverage has been demonstrated in many studies around the world. According to Mukalay, Mushadi et al [15], of the 509 subjects surveyed, 369 children were fully vaccinated (72.5%). Respondents were aware of the schedule and the benefits of vaccination (18.5% and 90.0% respectively). The main source of information for the vaccination appointment was health staff (86.9%). Reasons for non-vaccination were dominated by the mother's unavailability (42.4%) and lack of money (8.3%).

However, vaccination status varies depending on the context. This situation is exacerbated by the fact that measles vaccination is at the bottom of the vaccination schedule. It is also exacerbated by mothers' ignorance of the vaccination schedule, due to a lack of awareness among parents of the benefits of vaccination. This could be mitigated by introducing a second dose of VAR at school age, as is the case in developed countries. This would also make it possible to catch up with lost children and, above all, increase children's immunity.

4.4. Lethality due to measles

The results of this series show that the case fatality rate due to measles is 2.8%.

With regard to case-fatality, Médecins Sans Frontières [10] states that in contexts where infant mortality is greater than 100 per 1000 children, the case-fatality rate for measles can exceed 5%. In addition, the virus destroys certain cells in the immune system during the first few days of infection, making the infected person susceptible to other opportunistic infections.

Without vaccination, nothing can prevent many infants and children from contracting these diseases and even dying from them. In addition, many of the children who follow could suffer chronic health problems for the rest of their lives. We believe that geographical accessibility, capacity to understand (knowledge of the language and health issues) and the attractiveness of immunization services influence vaccination. The quality (actual and/or perceived) of services, as well as the appropriateness of the time, place and cultural context chosen to deliver these services to patients, also influence vaccination decisions.

4.5. Deaths by age group

During the study period, approximately 66.07% of measles deaths occurred in the 0-5 age group.

However, Mukalay, Mushadi et al [15] point out that without vaccination, nothing can prevent many infants and children from contracting these diseases and even dying from them. What's more, many of the children who follow could suffer chronic health problems for the rest of their lives.

This finding confirms that measles is a benign disease. Yet it is formidable in poor countries, where it causes many deaths.

The WHO estimates that one million children die each year from this disease worldwide, making it the third leading cause of death in children after diarrhea and respiratory infections [17].

According to a World Health Organization report published in 2020, most measles victims were children under the age of five. Infants and young children are the most vulnerable to infection by the virus. Vaccination saves lives, and is one of the great medical successes in the history of humanity. It saves around three million lives every year worldwide [5].

The under-fives are naturally the most vulnerable age group, as children at this age are often exposed to multiple diseases, leading to a high death rate. The aim of vaccination is twofold: on the one hand, it is individual protection against the corresponding infectious risks; on the other hand, it is collective protection aimed at excluding a disease with human-to-human contamination (e.g. measles), if vaccination coverage is comprehensive.

4.6. Source

Our study shows that 29.03% of measles cases came from the Panga 2 axis, which includes the health areas of Panga, Babise and Mosanda.

In a study carried out in Cameroon, Baonga et al [8] showed that coverage varied from 28.6% in the Etoa Meki health area to 85.7% in the Essos health area. The Nkolondom health area had the highest proportion of children who had not received any vaccine (14.3%), followed by the Nkolmessseng, Nfandena and Etoa Meki health areas (7.1%). The rural health areas of Nkolmesseng and Nkolondom performed better than some of the urban health areas (Nlongkak, Mvog ada, Etoa Meki); this trend towards better vaccine completeness among children in rural areas than in urban areas was highlighted by Wiysonge et al [18] in a meta-analysis of 24 demographic and health surveys conducted in sub-Saharan Africa between 2003 and 2010.

This situation can be explained partly by the geographical inaccessibility of the population and partly by the lack of qualified vaccination staff and parents' ignorance of the importance of vaccination and the vaccination schedule. As the Banalia Health Zone is essentially a mining area, many parents are involved in mining activities and do not bother at all about vaccinating their children. The further the children's place of origin is from the center, the lower the vaccination coverage rate.

4.7. Effectiveness of routine vaccination

With regard to routine VAR vaccination coverage, we observed that 84.58% of children aged 0-11 months had been vaccinated by VAR in September 2022.

This had already been observed in Senegal in 2012 by Ibrahim Seck et al [13], who found the VAR vaccination coverage rate to be over 80%, although this did not prevent a measles epidemic.

Despite the existence of an effective vaccine and generally good vaccination coverage, measles has not disappeared from developing countries, such as those in West Africa and Asia.

Various epidemiological studies have shown that the protective effect of the vaccine against the disease diminishes over time: for example, several years after being vaccinated, children may have a low level of antibodies against the measles virus and, during epidemics, may be affected by the disease, usually in a mild form.

This reduction in vaccine protection, which is not observed everywhere, could be explained by the frequency of other infectious diseases such as malaria, by early vaccination (9-10 months) and the absence of booster vaccinations, as well as by difficult living conditions (promiscuity, in particular, would encourage greater exposure). Although the vaccine may lose some of its effectiveness in such circumstances, it remains active: the mortality rate from measles remains much lower in vaccinated children than in those who are not vaccinated [11].

We believe that vaccination consists of immunizing a person against an infectious disease, generally by administering a vaccine. Vaccines, which stimulate the immune system, protect against infection and disease. Adherence to the vaccination calendar and complete vaccination coverage can ensure that the vaccine is effective in children. It's fair to say that a single dose of measles vaccine is unlikely to reduce measles-related morbidity and mortality in the Banalia Health Zone, as around 20.3% of children vaccinated with a single dose developed the disease. The second vaccination of children remains a major challenge for better control and elimination of measles in our country.

4.8. Limitations of the study

The main limitation of our study was memory bias, which could lead to misclassification of vaccination status. In our study, we had no precise information on the rate of possession of the vaccination card. The information was therefore completed by the mothers' declarations, which were checked by cross-referencing questions aimed at specifying the dates and places of vaccination, the site of administration, and the dose received and the presence of a scar (BCG). Providers were not considered in the search for factors associated with vaccine completeness. Future studies should look at this aspect.

5. Conclusion

The aim of the study was to list the epidemiological characteristics of measles cases in the Banalia Health Zone, to determine the incidence of measles in children aged 0-15 years, and to analyze the immunization status of children with measles.

Our investigations revealed that 64.60% of measles cases were in the 0-5 age group, with a peak in September 2022 of 40.77%. The vaccination rate was 39.19%, and the case fatality rate was 2.8%. Finally, 29.03% of measles cases came from the Panga 2 axis.

The measles epidemic remains a major challenge in the Banalia Health Zone, but also in other Health Zones in the Democratic Republic of Congo in general, and in Tshopo Province in particular. It is therefore important for the health authorities to step up surveillance and raise awareness in rural communities about measles vaccination in order to reduce the morbidity and mortality rate of this disease, which affects many children.

Parents' lack of knowledge about vaccination, missed opportunities and long waiting times are the most important factors in children not being vaccinated. To improve immunization coverage in the Banalia Health Zone, we suggest that parents be better educated about immunization and that immunization activities be better organized and planned.

Compliance with ethical standards

Authors contribution

All the authors were involved in the design of the study and the collection and analysis of the data. They also participated in the drafting and provided all the necessary critical intellectual contributions and approved the final version of the manuscript for submission. All authors assume full responsibility for all aspects of the study.

Disclosure of conflict of interest

The authors consider that there is no conflict of interest with regard to the content of the article.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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