PriMera Scientific
Medicine and Public Health
Volume 6 Issue 6 June 2025
ISSN: 2833-5627

Factors Associated with Measles During Epidemics in There Tshopo, Democratic Republic of Congo, From 2013 to 2023

Type: Case Report
Received: May 06, 2025
Published: June 04, 2025

Citation:
Franck d'Assise Mebwa Mohala., et al. "Factors Associated with Measles During Epidemics in There Tshopo, Democratic Republic of Congo, From 2013 to 2023". PriMera Scientific Medicine and Public Health 6.6 (2025): 03-11.

Franck d'Assise Mebwa Mohala[1]*, Alliance Tagoto[1], Emmanuel Tebandite[2], Michel Saliki[3], Theophile Yanyongo[1], Samuel Bosongo[1] and Joris Losimba Likwela[1]

[1]*Department of Public Health, Faculty of Medicine and Pharmacy, Unikis, Kisangani*

[2]*Department of Pediatrics, University Clinics of Kisangani, Unikis, Kisangani*

[3]*Higher Institute of medical Techniques of Bumba*

***Corresponding Author:** Franck d'Assise Mebwa Mohala, Department of Public Health, Faculty of Medicine and Pharmacy, Unikis, Kisangani, Adress: avenue Basai n°6 cite paradis Plateau Boyoma Commune MAKISO, Kisangani DRC.

Summary

Introduction: The objective of this study is to analyze the sociodemographic, environmental, health and political factors linked to measles during epidemics in the Tshopo province from 2013 to 2023.

Methods: A cross-sectional observational study based on retrospective data collection was conducted on confirmed measles cases between 2013 and 2023. A comprehensive sample of 3,739 confirmed measles cases from the literature review was used. Data were entered into an Excel sheet and analyzed using STATA®13 software.

Results: Individuals living in rural areas had a 3.07 times higher risk ($p < 0.0001$) of developing measles and were 28.1% less likely to be diagnosed than those in urban areas. Children under 5 years of age were 32.95 times more likely ($p < 0.0001$) to contract the disease. Males had a 1.14 times higher risk ($p = 0.0001$) than females. Vaccination status (Hazard Ratios: 0.7973) and good nutritional status (Hazard Ratios: 0.69) were associated with a significantly decreased risk of measles. The presence of complications was associated with a significantly increased risk of measles (2.6).

Conclusion: This study confirms the elevated risk in young children and highlights complex associations with vaccination status, nutritional status, complications, and residential environment. Survival analyses highlight the protective effect of vaccination against the development of complications and the negative impact of poor nutritional status.

Keywords: measles; associated factors; epidemic; Tshopo

Introduction

Measles, a highly contagious viral disease, remains a major public health problem worldwide. Despite global progress, epidemics persist in regions with inadequate vaccination coverage, threatening vulnerable populations and placing a strain on health systems [1].

In 2018, only 118 (61%) countries had achieved 90% measles vaccination coverage with the first dose (MCV1), and global coverage with the second dose of measles vaccine (MCV2) was only 69%, which is still far from the target of 95% coverage [1].

Although vaccination is one of the most effective and cost-effective public health interventions to reduce mortality and morbidity, approximately 1.4 million children die each year from vaccine-preventable diseases worldwide [3-5]. The estimated case fatality rate for measles is reported to be between 0.05% and 6%. This rate is worse in conflict settings [4, 5].

Studies in low-income countries indicate that measles vaccination has beneficial effects on child survival [6].

Mortality resulting from measles infection is often secondary to serious short- and long-term complications. These complications range from severe diarrhea and subsequent dehydration, to keratoconjunctivitis leading to blindness, as well as ear infections causing ear infections and sometimes resulting in permanent deafness [7]. Other complications include central nervous system involvement manifested by encephalopathies and severe respiratory infections such as pneumonia. Measles and its complications are particularly typical in malnourished children (especially with regard to hypovitaminosis A), unvaccinated children, children suffering from illnesses [7].

Malnutrition is a major contributor to death in 44.8% of childhood measles cases. Malnourished children are more likely to develop complications from measles and have a higher case fatality rate, while measles infection can in turn worsen the nutritional status of children. Measles has a negative impact on both mortality and the nutritional status of surviving children [8].

One in 20 children with measles develops pneumonia and 1 in 1000 develops encephalitis, 15% of whom die and 25-35% suffer permanent neurological damage [9].

After a long period of stability, large measles epidemics occurred in several World Health Organization (WHO) provinces with more than 140,000 deaths worldwide in 2018 [10]. These epidemics have been attributed to insufficient vaccination rates in certain settings. [11] or unvaccinated clusters, which occur even in countries with high vaccination rates [12]. These unvaccinated clusters make measles a persistent public health threat, particularly in a globalized world with increasing travel habits [13].

In the Democratic Republic of Congo (DRC), between 2012 and 2019, administrative coverage of measles vaccine ranged between 88% and 92%, while WHO-UNICEF estimates of coverage with the first dose of measles vaccine (MCV1) ranged between 57% and 72% [14].

According to the national coverage survey conducted by the Kinshasa School of Public Health, vaccination coverage in VAR is estimated at 55.9% in the 26 provinces, including 19.7% in Tshopo [15].

Despite immunization efforts over the past five years, there remains a 20-point gap between administrative coverage and annual WHO and UNICEF estimates. The complexity and multiplicity of factors that influence health status, as well as their socioeconomic aspects, deserve to be integrated into strategies aimed at achieving measles elimination by 2030 [16].

Since information on measles resurgence serves as a marker of health system weaknesses and persistent inequalities in access to care and measles control therefore plays an important role in strengthening vaccination programs and contributing to primary health care [17]. This study will attempt to determine the factors associated with the measles epidemic in Tshopo province.

Materials and Methods

Type and period of study

This was a cross-sectional study with analytical aims conducted on data collected retrospectively among annual measles cases during the period from January 1, 2013 to December 31, 2023.

Study framework

This study was conducted in the city of Kisangani, in the Tshopo province in the northeastern region of the DRC. Using the documentary review, we collected data on cases and deaths due to measles notified and confirmed by the National Institute of Biomedical Research (INRB) by biological tests (ELISA or RT-PCR) and notified to the health authorities through the DSE between 2013 and 2023. These data were extracted from the database of the epidemiological surveillance directorate of the National Ministry of Public Health, Hygiene and Social Welfare between 2013 and 2023. occurred in the Tshopo province.

Study population

All cases and deaths related to measles recorded in the database of the Epidemiological Surveillance Directorate (DSE) of the National Ministry of Public Health, Hygiene and Social Security in the DR Congo between 2013 and 2023.

Sampling

This was a comprehensive sample of 3,739 cases and deaths due to measles confirmed by the National Institute of Biomedical Research (INRB) by biological tests (ELISA or RT-PCR) and notified to the health authorities through the DSE between 2013 and 2023.

Data collection technique

This was a documentary review of the INRB measles results database (containing all cases of measles confirmed by laboratory tests carried out by the INRB).

Data analysis

These data were entered into Excel sheets and analyzed using STATA®13 software. Descriptive statistics (calculation of frequency, proportion, numbers and means with their standard deviations) were performed. Variables with a normal distribution were compared with the Student t-test and others, by the Kruskal-Wallis non-parametric test. In addition, the Chi-square test of independence was used to compare the two proportions. We estimated the survival function using the Kaplan-Meier method (Product Limit estimate) and the multivariate Cox regression model allowed us to determine the factors associated with measles during epidemics in Kisangani. The association value was determined with a 95% CI and used with the significance level set at a p-value less than 0.05. While respecting the principle of anonymity, we requested and obtained approval from the INRB for the patient data available in its database using exclusively the unique identification number assigned to each subject included in the study.

Results

A total of 3,739 cases and deaths due to measles confirmed by the INRB were collected, including 1,345 rural cases and 2,395 urban cases. The majority were under 5 years of age (2,775). They were female (2,044), unvaccinated (2,112), with good nutritional status (2,929) and a mean hospital stay of more than 4 days (2,524) (Table 1). The risk of developing measles was 3.07 times higher in rural areas than in urban areas (crude OR = 3.07, p-value < 0.0001); 32.95 times higher in children under 5 years of age than in those over 5 years of age (crude OR = 32.95, p-value < 0.0001); 2.24 times higher in vaccinated than in unvaccinated individuals (crude OR = 2.24, p-value < 0.0001); 2.23 times higher in individuals with a malaria diagnosis than in those without a diagnosis (crude OR = 2.23, p-value < 0.0001); 2.68 times higher in subjects with comorbidities than in individuals without problems (crude OR = 2.68, p-value < 0.0001) but 0.46 times lower in individuals with good nutritional status compared with those suffering from malnutrition (crude OR =

0.46, p-value < 0.0001). Male subjects were 1.14 times more likely to contract measles than female subjects (crude OR = 1.14, p-value = 0.000).

It is 0.09 times lower in people who died in hospital than in people who recovered (crude OR = 0.09, p-value < 0.0001). Individuals with comorbidities are at risk of measles.

Variables	***Measles Yes n(%)***	***Raw Gold***	***p value***
Place of residence			
Rural	1345	3.07 (2.87 - 3.29)	0.0000
Urban	2394		
Age groups			
≤5 years	2773	32.95 (40.32 -40.76)	0.0000*
>5 years	966		
Sex			
Female	1695	1.14 (1.07-1.22)	0.000
Male	2044		
Vaccination status			
Vaccinated	1627	2.24 (2.09 - 2.39)	0.0000
Unvaccinated	2112		
Nutritional status			
Good	2929	0.46 (0.42 - 0.49)	0.0000
Bad	810		
Diagnosis of malaria			
Positive	362	2.233 (1.98 - 2.49)	0.0000
Negative	3377		
Exit mode			
Cured	3386	0.09 (0.08- 0.11)	0.0000
Deceased	353		
Average length of hospital stay			
≤4 days	1215	1.01 (4.34- 4.36)	0.0000*
>4 days	2524		
Complications			
Absence	3109	2.68 (2.45 - 2.94)	0.0000
Presence	630		
** T-test*			

Table 1: Distribution of measles cases according to sociodemographic characteristics.

Comparative survival analysis

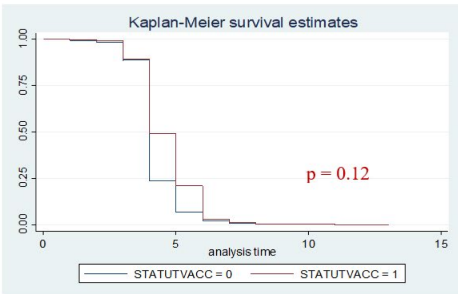

Figure 1: Survival analysis of vaccinated and unvaccinated children by discharge modalities.

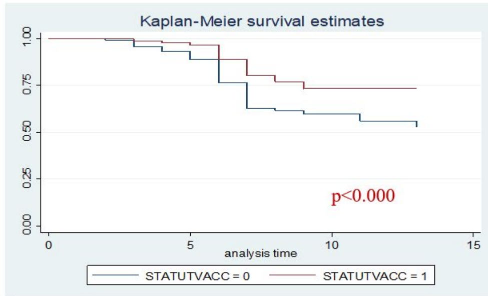

Figure 2: Survival analysis of vaccinated and unvaccinated children according to the occurrence of complications.

The survival curve (Figure 1) indicates that vaccinated patients have a greater probability of avoiding the complication studied compared to unvaccinated patients, especially after approximately 4 time units. Although the complication eventually appears in both groups over time, it occurs later and in fewer vaccinated patients. However, this observed association is not statistically significant ($p = 0.12$). The survival curve (Figure 2) suggests that vaccination is associated with a reduced probability of developing the complication analyzed in vaccinated patients compared to unvaccinated patients throughout the follow-up period. The separation of the curves suggests a possible protective effect of vaccination, and this association is statistically significant ($p < 0.000$).

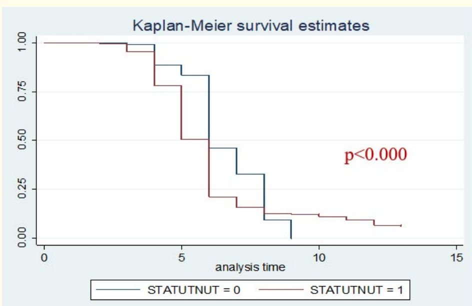

Figure 3: Analysis of time to complications by nutritional status.

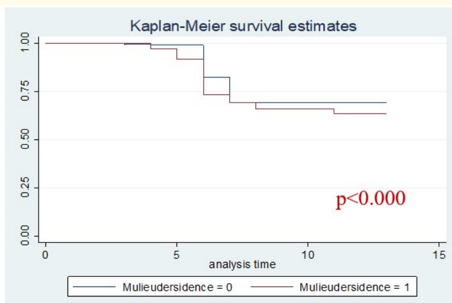

Figure 4: Analysis of time to the occurrence of complications according to residential environment.

Figure 3: Kaplan-Meier shows that good nutritional status is associated with significantly higher survival (0.60 vs 0.10) in patients with measles, a highly significant difference ($p<0.0000$), highlighting the importance of nutrition.

Figure 4: Kaplan-Meier indicates that rural area is associated with slightly lower survival (0.60 vs 0.65) and earlier risk of measles-related complications, a significant difference ($p<0.0000$).

Variables	*Measles Hazard Ratio*	*Conf. Interval 95%*	*P>/z/*
Vaccination status	0.7973	0.7782-0.8163	0.000
Nutritional status	0.69	0.6704-0.7134	0.000
Complications	2.6	1.8753-2.0193	0.000

Table 2: Cox regression analysis according to the child's vaccination and nutritional status, complications and discharge arrangements.

Vaccination status (HR: 0.7973) is associated with a decreased risk of contracting measles of approximately 20.27%. The confidence interval (0.7782 - 0.8163) indicates that the protective effect of vaccination status is statistically significant (0.000). Better nutritional status (HR: 0.69) is associated with a decreased risk of contracting measles of approximately 31%. The confidence interval (0.6704 - 0.7134) indicates that the protective effect of vaccination status is statistically significant (0.000). The presence of complications (HR: 2.6) is associated with an increased risk of contracting measles by a factor of 2.6. The confidence interval (: 1.8753 - 2.0193) indicates that the protective effect of vaccination status is statistically significant (0.000).

Discussion

According to sociodemographic characteristics and healthcare provision

According to our study, 3,739 cases were laboratory-confirmed as measles. However, it is worth noting that 43.5% of confirmed cases had previously received a measles vaccine. Young children have a higher prevalence of confirmed measles cases, particularly in the 12-59 month age group (60.8%). The risk of measles is higher due to malnutrition and malaria.

Children under 5 years of age had a 32.95 times higher risk of measles than those over 5 years of age (crude OR = 32.95, p-value < 0.0001). Male subjects had a 1.14 times higher probability of contracting measles than female subjects (crude OR = 1.14, p-value = 0.000). Among individuals who died in hospital, the risk of measles was 0.09 times lower than that of recovered individuals (crude OR = 0.09, p-value < 0.0001). As for the risk of hospitalization, it was higher (crude OR = 2.24; 95% CI: 2.15-2.32) in children under 2 years of age. In addition, an increased risk of hospitalization was observed among unvaccinated cases compared to cases who reported vaccination. Additionally, more frequent hospitalization was observed among unvaccinated cases than among those reporting prior vaccination (crude OR = 3.17; 95% CI: 3.08-3.27).

In their series, Sodjinou et al [18], found that 2.9% of suspected cases were sampled for laboratory confirmation. Among the confirmed cases, 40.7% had previously received a measles vaccine. From the analysis, it was found that children under 5 years of age have the cumulative incidence rate of confirmed measles, followed by children 5 to 9 years of age. Among children under 5 years of age, 41% of measles cases were laboratory confirmed. Laboratory confirmed measles cases in vaccinated children under 5 years of age. Lack of routine vaccination has been reported to be one of the major causes of measles in other African countries such as Madagascar, Kenya, Cameroon, and Ethiopia. In their research on the resurgence of measles in Brazil Makarenko et al [19], stated: In 2019 15,598 cases of measles were detected in the state of São Paulo, of which 2,039 were admitted to hospital and 17 lost their lives. Nearly 40% of confirmed cases (6,302) mentioned having been vaccinated in advance against measles.

The 15,598 confirmed cases in 2019 were composed of 52.1% males (8,123) and 47.9% females (7,471). 18-29 year olds (39.7%; 6,190) were the most affected age group, followed by children under five years of age (32.8%; 5,124). The proportions of previous vaccination between females (43.2%) and males and males (37.9%) showed a significant difference (p < 0.001). Among individuals who progressed to recovery (41.3%) and those who had died (17.6%) (p = 0.04). As for the risk of hospitalization, it was higher (IR = 2.19; 95% CI: 1.66-2.88) in children under 5 years of age.

Furthermore, there was a higher risk of hospitalization among the unvaccinated than among those who reported prior vaccination (IR = 1.59; 95% CI: 1.45-1.75).

According to the analyses comparative survival

In our series, the survival curve shows that vaccinated patients are associated with a higher probability of not developing the complication studied compared to the group of unvaccinated patients, especially after approximately 4 units of time. Although the complication eventually occurs in both groups over time, it appears to occur later and in a lower proportion in the group of vaccinated patients.

In the series of Aurangzeb et al [9] pneumonia, diarrhea with dehydration and encephalitis were the most common complications. Hospital stay averaged 3.8 days and was longer in malnourished children. Mortality was 3.4% and was significantly associated with young age, lack of vaccination and the presence of encephalitis.

Our study shows that vaccination status is associated with a lower probability of developing the complication compared to the group, throughout the observation period. The difference between the two curves indicates a potential protective effect of vaccination status. The survival curve clearly demonstrated the effectiveness of measles vaccination in preventing the complication studied.

The study by Mogensen et al [20] observed a three to four times lower mortality in children vaccinated against measles compared to those not vaccinated, an effect considered important. Although the “real” effect of the vaccine compared to no vaccination was not established by randomized trials in high mortality countries before its introduction, small studies have shown significant reductions in mortality in young vaccinated children, as high as 91% in Sudan and 67% in Guinea-Bissau. Studies of natural experiments also corroborate a major impact of the measles vaccine on mortality.

According to Aaby et al [21] measles vaccination before the age of 13 months significantly reduces all-cause mortality (protective efficacy of 64%). In contrast, vaccination after 12 months does not show a difference in survival. Moreover, studies in developing countries have generally observed significant reductions in mortality (40 to 50%) with measles vaccination compared to no vaccination.

In our study the survival curve in our study suggests that patients who did not have good nutritional status appear to have a higher probability of developing measles complications more quickly and in greater numbers than the group who initially had good nutritional status.

The study by Aurangzeb et al [9] reveals a high prevalence of malnutrition (71%, more than half of which was severe) in patients with measles, and that malnutrition is associated with a significantly longer hospital stay. Although the majority of patients are malnourished, mortality is not significantly related to it in this study, which could be due to the study design or regional specificities (such as lower mortality in Asian malnourished children compared to Africans, mentioned in the original text The study also highlights that a significant proportion of measles cases develop complications requiring hospitalization.

According to Eric B. Schneider [22] the analysis of measles complications at life stage three (in slightly older children) could help to understand how nutritional status influences these complications and thus extrapolate these conclusions to younger children. In this life stage, 10% of children developed measles complications.

This survival curve shows a modest difference in the probability of not developing the complication between the two groups (0 = urban and 1 = rural). Initially, the group of patients with a rural residential environment have a slightly higher risk of developing complications than those from the urban environment.

According to Navideh Noori et al [23] in his article on Potential Impacts of Mass Nutritional Supplementation on Measles Dynamics: A Simulation Study the majority of children with measles were from urban areas with low parental income. Although this may be biased by the urban location of the hospital, studies suggest that poor urban populations may play an important role in the transmission of measles to rural areas.

limitations of the study

- The total number of cases reported in this study may be influenced by underreporting of cases.

- It can be difficult to verify the reported vaccination status of cases due to the lack of vaccination cards and, in many cases, it is not specified by obvious documentation such as vaccination cards.

Conclusion

The DRC has experienced frequent measles epidemics over the past decade. Beginning well before our study period, the epidemics were widespread and prolonged between 2013 and 2023.

This study provides important information on the factors associated with measles in Tshopo province. It confirms the high risk among young children and highlights complex associations with vaccination status, nutritional status, malaria. Comorbidities and residential environment. Survival analyses highlight the protective effect of vaccination against the development of complications and the negative impact of poor nutritional status. Therefore, it is desirable to promote awareness to support vaccination activities.

References

1. Misin A., et al. “Measles: An Overview of a Re-Emerging Disease in Children and Immunocompromised Patients”. Microorganisms 8.2 (2020): 276.
2. Perry RT., et al. “Progress toward regional measles elimination--worldwide, 2000-2013”. MMWR Morb Mortal Wkly Rep 63.45 (2014): 1034-8.
3. Khan J, Shil A and Prakash R. “Exploring the spatial heterogeneity in different doses of vaccination coverage in India”. PloS One 13.11 (2018): e0207209.
4. http://www.euro.who.int/en/media-centre/sections/press-releases/2019/over-100-000-people-sick-with-measles-in-14-months-with-measles-cases-at-an-alarming-level-in-the-european-region,-who-scales-up-response
5. https://www.who.int/news-room/fact-sheets/detail/measles
6. Benn CS and Aaby P. “Measles vaccination and reduced child mortality: Prevention of immune amnesia or beneficial non-specific effects of measles vaccine?”. J Infect 87.4 (2023): 295-304.
7. “A Retrospective Investigation of a Measles Outbreak in a District in North-western Nigeria”. World Journal of Public Health.
8. Noori N., et al. “Potential Impacts of Mass Nutritional Supplementation on Measles Dynamics: A Simulation Study”. Am J Trop Med Hyg 107.4 (2022): 863-72.
9. Aurangzeb B., et al. “Clinical Outcome in Children Hospitalized with Complicated Measles”. J Coll Physicians Surg Pak 15.9 (2005): 547-51.
10. Hj L., et al. “Understanding vaccine hesitancy around vaccines and vaccination from a global perspective: a systematic review of published literature, 2007-2012”. Vaccine 32.19 (2014).
11. Leong WY. “Measles cases hit record high in Europe in 2018”. J Travel Med 25.1 (2018): tay080.
12. One size does not fit all: local determinants of measles vaccination in four districts of Pakistan. BMC International Health and Human Rights.
13. Márcia de Cantuária Tauil, Ana Paula Sayuri Sato and Eliseu Alves Waldman. “Factors associated with incomplete or delayed vaccination across countries: A systematic review”. Vaccine 34.24 (2016): 2635-43.
14. World Health Organization Regional Committee for Africa Progress towards measles elimination in the African region by 2020: information document (2017).
15. Vaccination coverage survey among children aged 6-23 months in the Democratic Republic of Congo. Study report from the Kinshasa School of Public Health (2022).
16. Matondo FS., et al. “Determinants of measles outbreak in the city of Kinshasa, Democratic Republic of the Congo in 2022: A case-control study”. J Interv Epidemiol Public Health (2024).
17. Strategic Measles Outbreak Response Plan: 2021-2023: Measles Outbreaks: Prevention, Preparedness, Response, and Recovery.
18. Vincent Dossou Sodjinou., et al. “Epidemiological characteristics of a protracted and widespread outbreak in the Democratic Republic of Congo, 2018 – 2020”. Pan African Medical Journal (2022).

19. Cristina Makarenko., et al. "Measles resurgence in Brazil: analysis of the 2019 epidemic in the state of São Paulo". Rev Saude Publica (2022).
20. Mogensen SW., et al. "Introduction of standard measles vaccination in an urban African community in 1979 and overall child survival: a reanalysis of data from a cohort study". BMJ Open 6.12 (2016): e011317.
21. Aaby P., et al. "Reduced childhood mortality after standard measles vaccination at 4-8 months compared with 9-11 months of age". BMJ 307.6915 (1993): 1308-11.
22. Schneider EB. "The effect of nutritional status on historical infectious disease morbidity: evidence from the London Foundling Hospital, 1892-1919". Hist Fam 28.2 (2023): 198-228.
23. Noori N., et al. "Potential Impacts of Mass Nutritional Supplementation on Measles Dynamics: A Simulation Study". Am J Trop Med Hyg 107.4 (2022): 863-72.