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Descriptive Characterisation of Suspected Measles Cases in Sokoto State 2010 -2016: A Secondary Data Analysis

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Abstract

Background: Measles is a disease with worldwide distribution; however, control efforts have substantially altered the global distribution. The incidence has decreased considerably in regions where routine vaccination is strong; however, this is not the case in developing countries like Nigeria. This study aims to describe the distribution of measles cases in Sokoto state in time, place and person.

Methods: Descriptive analyses of measles surveillance data between 2010 and 2016 was carried out to describe the epidemiology of measles in Sokoto State in Time, Place and Person. Microsoft Excel and IBM SPSS were used to analyse the data. We reported frequencies and proportions; cross-tabulations and chi-square tests were used to find associations between variables.

Results: A total of 13974 suspected cases of measles were line-listed between January 2010 and June 2016. Overall, 11008 (78.8%) were below five years, and 7421 (53.1%) were males. A majority, 12896 (92%), of the suspected measles cases were reported in the first half of each year of evaluation. Gwadabawa Local Government Area (LGA) recorded the highest measles cases, 1881 (14%). Ten thousand and twenty-seven (71.8%) of suspected measles cases did not receive the measles vaccine. The overall Case Fatality Rate (CFR) was 0.9%. However, Bodinga LGA had the highest CFR of 4%. Only 605(4%) suspected measles cases were tested for Measles IgM. One hundred and twenty-five (0.9%) deaths were recorded. Factors significantly associated with deaths are measles vaccination status ($p = 0.001$) and admission status ($p < 0.001$).

Conclusion: There is the persistence of measles over the period affecting primarily children below five years with a low CFR. However, a majority of the children did not receive their measles vaccine. Based on this finding, measles will remain a public health problem unless significant efforts are put into place to increase vaccination coverage.

Keywords: Measles, Analysis, Surveillance, Sokoto Nigeria

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Introduction

Measles is one of the most contagious diseases known to man. Measles often occurs in explosive epidemics (1). It has greater than 90% secondary attack rates among susceptible persons (1, 2). Humans are the only natural hosts of the virus, and no other animal reservoirs are known to exist. Because of these biological characteristics, measles has been targeted for eradication (3). However, due to social and political factors and high transmissibility, elimination has been achieved in only a few areas of the world (4, 5).

Measles is a disease with a worldwide distribution; however, control efforts have substantially altered the global distribution. The incidence has decreased considerably in regions where vaccination has been instituted (6). Despite the increase in measles immunization coverage aimed at building population immunity, measles outbreaks still occur, especially in the developing countries. This ranks measles top among the burden of Vaccine-Preventable Diseases (VPDs) across the globe, with the worst picture seen in the developing countries which has been worsened by malnutrition and overcrowding (7, 8). The overwhelming majority (more than 95%) of measles deaths occur in developing countries (7). The Case Fatality Rate (CFR) of measles in developing countries is around 3-5%. This rate could be as high as 10% during epidemics, with those under five years most affected (9-11). Interrupting transmission of this fatal disease requires an effort to achieve population immunity of at least 95% (8).

To address the high mortality caused by measles annually in Africa, countries in the World Health Organization (WHO) African region in 2001 adopted the accelerated measles control activities using the measles mortality reduction strategies recommended by the WHO and the United Nations Children's Fund (UNICEF). These strategies include: achieving and maintaining 80% coverage with routine measles vaccination of infants, providing a second dose of measles vaccine through supplemental immunization activities (SIAs), intensified measles case-based surveillance with laboratory confirmation and improve

measles case management during an outbreak (12, 13).

Measles has been reported as a significant cause of childhood morbidity and mortality in Nigeria (1). Nigeria is among the 45 countries that account for 94% of the global deaths due to measles (9). While there is a paucity in the literature in Nigeria on the population-based prevalence of measles, studies from tertiary hospitals show the prevalence of measles from paediatric admissions stands at around 1.3-5.1% (14, 15). Furthermore, the reported CFRs for this disease in Nigeria showed variations ranging from 1.9% to 12.4% (14, 15). This study aims to describe the characteristics of the suspected measles cases in Sokoto state in time, place and person.

MATERIALS AND METHOD

Study Area

The study was conducted in Sokoto state, located in North-Western Nigeria. The study was carried out in Sokoto metropolis, Sokoto state. Sokoto State has a land area of 28,232.37 sq kilometre and is located between longitudes 11° 30" to 13° 50" East and latitude 4° to 6° North. It is bordered in the North by Niger Republic, Zamfara State to the East and Kebbi State to the South and West (16). Sokoto state has 23 Local Government Areas (LGAs), of which four are metropolitan. These are: Sokoto North, Sokoto South, Wamakko and Dange-Shuni LGAs

Description of Measles Case-based Surveillance in Sokoto state

Surveillance is critical in the prevention of measles outbreak (8). The surveillance system for measles, referred to as "measles case-based surveillance," is a system that detects suspected measles cases and outbreaks. In 2006, measles case-based surveillance became operational in Nigeria using the resources and infrastructure of the already established surveillance for Acute Flaccid Paralysis (9, 13). The case-based surveillance system was put in place to detect cases and outbreaks of measles. It involves immediate reporting and investigating any suspected case of measles by clinicians using standard case definition, evaluating immunization efforts, and predicting outbreaks by identifying geographical areas and age groups at risk (17).

The measles case-based surveillance system in Sokoto requires that all cases suspected by clinicians in all health facilities must be reported immediately to the Local Government Area (LGA) Disease Surveillance and Notification Officer (DSNO) in the LGA health facility is located. The reporting form is used for notifying the first five cases, after which any other new case is line-listed.

For every suspected measles case, an individual case

investigation form is completed. In addition, a blood specimen is collected and sent to the national reference laboratory for testing for measles-specific immunoglobulin M (IgM) antibodies. The designated LGA DSNO at the LGA Primary Health Care (PHC) Department is responsible for completing the forms and transportation of the specimen.

After an outbreak has been confirmed as measles, subsequent cases are also investigated with serum samples collected alongside nasopharyngeal swabs of at least five cases identified within five days of onset of rash for viral isolation. All other new cases from which serum specimens are not collected are line-listed and are confirmed by epidemiological linkage.

Case Definitions

A suspected measles case is any person with generalized maculopapular rash and fever plus one of the following: cough, coryza (runny nose) or conjunctivitis or in any person in whom a physician suspect measles (18). A laboratory-confirmed case of measles is defined as a suspected case with serological confirmation of measles specific IgM antibody in a person who had not received measles vaccination within 30 days before the specimen collection. In contrast, measles associated death is defined as any death from illness in a confirmed case of measles within one month after the onset of rash. A suspected outbreak is the occurrence of greater than five reported suspected cases of measles in a health facility or district in a month. A confirmed outbreak of measles, is the occurrence of greater than three laboratory-confirmed measles cases in a health facility or district in one month. An epidemiologically linked case is one without a blood specimen collected and is linked in person, place and time to a laboratory-confirmed case (18).

Type and Source of Data

Routine measles surveillance data was used for this secondary data analysis. The data was obtained from Sokoto state Ministry of Health. The data was in an excel spreadsheet. The data analysed was gathered between 2010 and 2016. The major variables include age, sex, LGA, measles vaccine received, admission status, date of onset of rash, laboratory specimen taken and results of measles IgM.

Data Analysis

After obtaining the data, the data for the different years were merged into one database. This was then followed by data cleaning to ensure that the merged data are all in the same format. We used IBM SPSS version 25 and Microsoft Excel for data analysis. We conducted descriptive analyses to describe the epidemiology of measles in Sokoto State in Time, Place and Person. Graphs and charts were used to depict the data visually. Cross tabulations and Chi-square test, crude Odds Ratio (cOR) and 95% Confidence Interval (CI) were used to find

associations between variables. We calculated the Case Fatality Rate (CFR) by dividing the number of mortalities by the total number of cases multiplied by 100. All analyses were considered statistically significant at $p < 0.05$.

RESULTS

A total of 13974 suspected measles cases were seen between 2010 and 2016 in Sokoto state. Majority of the suspected measles cases, 11008 (78.8%) were below five years. Slightly above half, 7421 (53.1%) were males, and only 3947 (28.2%) had at least one dose of measles vaccine. When stratified by sex, 2093 (28.2%) males and 1854 (28.3%) females had at least one dose of measles vaccine. Over the evaluation period, only 60 (0.4%) were admitted, and 125 (0.9%) died within the period. A total of 12496 (89.4%) of the suspected measles cases were seen in a Primary Health Care (PHC) facility, and 13914 (99.6%) were seen as outpatients (Table 1).

Table 1. Characteristics of suspected measles cases in Sokoto state 2010 to 2016.

Variable	Frequency (n = 13974)	Percent
Age group (years)		
< 5 years	11008	78.8
5 – 9 years	2524	18.1
10 – 14 years	237	1.7
≥ 15	205	1.5
Sex		
Male	7421	53.1
Female	6553	46.9
Measles vaccine doses		
Zero dose	10027	71.8
At least one dose	3947	28.2
Outcome		
Died	125	0.9
Alive	13746	98.4
Unknown	103	0.7
Place of treatment		
Dispensary	66	0.5
PHC	12496	89.4
General hospital	2	0.0
Not recorded	1410	10.1
Admission		
Inpatient	60	0.4
Outpatient	13914	99.6

Most of the cases, 12896 (92.3%), were seen in the first half of each year. Figure 1 shows graphically the trend of distribution of cases by month.

Figure 1: Trend analysis of suspected measles cases based on the month of occurrence between January 2010 and June 2016 in Sokoto state

Over the period, only Gudu, Tangaza and Wamakko had less than ten measles cases per 1000 population while Yabo, Silmae Rabah, Goronyo and Gwadabawa had more than 30 cases per 1000 population (Figure 2).

Figure 2: Distribution of suspected measles cases in Sokoto State between 2010 and 2016

Overall, the CFR for measles in the state between 2010 and 2016 was 0.9%. Bodinga LGA had the highest CFR rate of 4.1%, while Sokoto south, Tangaza, Wamakko and Gudu had no fatality (Figure 3). The CFR 0.9 was highest among children less than five years, while no mortality was recorded among those older or equal to 15 years (Table 2).

Figure 3: CFRs in different LGAs in Sokoto state between 2010 and 2016.

Table 2. CFR of suspected measles cases in Sokoto state between January 2010 and June 2016 by age group

Age	Suspected measles cases	No. of deaths	CFR (%)
< 5 years	11008	101	0.9
5-9 years	2524	23	0.9
10-14 years	237	1	0.4
≥15	205	0	0

Over the period, only 605 suspected measles cases were investigated. Out of this, 20 (3.3%) had IgM positive results (Figure 4).

Those less than five years old were more likely to have died of measles (OR: 1.20, 95%CI = 0.75 -1.89); however, this was not statistically significant, $p = 0.4534$. Those admitted had a higher risk of dying than those less than five years old were more likely to have died of dying

measles (OR: 1.20, 95%CI = 0.75 -1.89); however, this was not statistically significant, $p = 0.4534$. Those admitted had a higher risk of dying than those who were outpatients (OR: 20.8, 95%CI = 10.02 -43.31), $p < 0.001$ (Table 3).

Figure 4: Distribution of Measles IgM result among suspected measles cases in Sokoto between 2010 and 2016

Table 3: Factors associated with outcome status among suspected measles cases in Sokoto state between 2010 and 2016

Variables	Outcome		OR(95% CI)	Chi-square, p-value
	Died No(%)	Alive No(%)		
Age				0.6159, 0.4534
<5 years	103(82)	10936(80)	1.20(0.75 – 1.89)	
≥ 5 years	22(18)	2810(20)		
Sex				0.1892 , 0.6636
Male	64(51)	7306(53)	0.9(0.65 – 1.31)	
Female	61(49)	6440(47)		
Measles				11.755, 0.001
Zero dose	80(64)	9906(77)	0.53(0.37 – 0.76)	
At least one dose	45(36)	2960(23)		
Admission				134.12, <0.001
Inpatient	9(7)	51(4)	20.8(10.02 – 43.31)	
Outpatient	116(93)	13695(96)		
Measles IgM/antibody result				5.9457, 0.015
IgM positive	2(2)	18(6)	6.4(1.16 – 35.54)	
IgM negative	5(71)	290(94)		

DISCUSSION

Children below the age of five years accounted for the majority of the suspected measles cases. Measles primarily affects children under the age of five. However, it can affect any age group. This study shows that the most affected age group was those below the age of five years. This is a similar picture found in southwestern Nigeria (19). Similarly, a 10-year study in Lagos (20) and a study in Niger state (21) revealed that 76% and 77% respectively of cases were below the age of 5 years. The result is also aligned with findings from a systematic review on measles trends in Nigeria, where a majority of the cases were below 59 months (8). The high percentage among the under-five could have been due to the low immunization rate among the under-fives in Sokoto state (22). The above emphasizes the age groups most prone to the infection and hence the need for booster doses or supplementary immunization as it is being done on National Immunization Days (NIDs) even though the prevalence of obtaining the first dose is still low.

The analysis revealed that between 2010 and 2016, the suspected measles cases were consistently had margin-

ally higher among males than females. This was a similar picture seen in a study that evaluated measles morbidity and mortality trend over a ten-year period (20). Also, another study reported that the overall number of reported cases for the study period was marginally higher for males than females (23).

Measles is a disease that can occur at any time of the year. In this study, measles cases were found to occur throughout the months of the years for the seven years, with peak incidence occurring during the first quarter of the year; this period is dry and dusty in Sokoto state. This finding could be because, during the dry and dusty season, there is a higher incidence of upper respiratory tract disease that can lead to symptoms such as sneezing and coughing. Measles is a contagious disease caused by a virus that leaves in the nose and throat of infected people. The public health implication is that more cases will occur during the peak of the dry season and health authorities need to schedule measles vaccination campaigns before the peak period to prevent outbreaks. This picture is similar to what was reported in Southwestern Nigeria, where most of the cases were seen in the dry season (24). A contrary result was reported in a hospital-based prevalence study in Northcentral Nigeria, where most of the reported cases were reported in the last quarter of the year (21). This disparity observed between our study and the study in southwestern Nigeria may be because the study in Southwestern Nigeria was conducted in a tertiary hospital which may not necessarily represent what is happening in the community. In our research, most cases were reported in the PHC, which is the first point of contact with the health system for most people, explaining the disparity observed. Another study carried out in the southwest found the peak incidence of occurrence in April and August, the dusty and humid months in southwest Nigeria.

Vaccination coverage of Measles Containing Vaccine (MCV) in Nigeria, according to WHO/UNICEF, is currently put at 54% (25). In this study, about two-thirds of the suspected measles cases did not receive any dose of the measles vaccine. This finding is especially worrisome because about 95% of children under five years need to be vaccinated for herd immunity (26). This could explain why there are recurrent outbreaks of measles in Sokoto state. The finding in this study is similar to what was obtained in a previous study in which 82.6% of the cases did not receive measles vaccination (21, 24). In addition, slightly more males received at least one dose of measles vaccines than females. A similar picture was also obtained in a previous study where slightly more males received the MCV vaccine. The possible explanation for all the above could be the rejection of some vaccines by some northerners, poor utilization of healthcare services, lack of awareness, poor educational background of the parents, and poor socioeconomic status (8).

The analysis revealed that measles mortality was slightly higher among males than females. This is similar to results in studies elsewhere in Nigeria (20, 21). However, the result is in contrast to the findings in Europe, where data had suggested that measles mortality may be higher in girls by 5% (27). This finding may be due to preferential presentation of a male child for medical attention. In our study environment, this is an already established culture due to general male preference of the family (28), or there could just be some genetic factors related to sex chromosomes that predispose male children more to the disease.

A majority of the suspected measles cases did not receive any MCV. This finding is in line with a previous study where all the measles associated mortality occurred among the children without measles vaccination (21). The gender similarity in terms of the vaccination status may be due to increased activities of gender equity globally, which is the focus of the third millennium development goal, and this is a good development in a country where preferential treatment of male children has been documented in previous studies (28).

The CFR observed in this study is lower than that recorded in the past for Nigeria (29) and in hospital-based studies (14, 15, 30). The likely explanation for this difference could be that most of the cases in the hospital are more severe, thus accounting for the higher CFR. In addition, studies have demonstrated that vaccination programs shift disease burden out of the age group with the highest case fatality (31). This is apparent in this study because the highest CFR has been observed among those below five year of age, which is the group with the highest CFR.

In conclusion, the analysis of the measles surveillance data between January 2010 and June 2016 has given an insight into the epidemiology of measles in Sokoto State. There is the persistence of measles over the period affecting primarily children below five years with a low CFR. However majority of the children did not receive their measles vaccine. Based on this finding, measles will remain a public health problem unless major efforts are put into place to ensure that vaccination coverage increases and awareness programs strengthened.

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