

Malnutrition Precipitated Measles Outbreak in Gewane District, Afar Regional State, Northeastern Ethiopia, 2016

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Research Article

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Abstract

Background: Measles is a contagious viral and vaccine-preventable disease that is continuing a public health problem. It is occurring as an outbreak not only in developing but also in developed countries.

Methods: A 1:2 ratios, unmatched case-control study was conducted from September 19/2016- October 08/2016 in Undufo Kebele, Gewane district, Northeastern Ethiopia. Both confirmed by laboratory and epidemiologically linked measles cases were involved. Controls were those who had no clinical signs of measles during the data collection period and residents of the same community where cases were identified. An interviewer-administered questionnaire was used to collect data. Nutritional status was measured using MUAC and the result decided based on the world health organization's nutritional categorization of children by MUAC. Data were entered into Epi-info 7 and analyzed using SPSS-21. Binary logistic regression was done to identify risk factors for measles infection with 95% confident level of Odds ratio.

Result: Fifty cases and 100 controls have participated in this investigation. Four out of five samples collected were positive for measles IgM antibody. There were three deaths reported. There was no vaccination history of cases and controls. The majority of cases were female and between 6–15 years of age. In multivariable analysis, malnutrition (AOR = 3.21; 95%CI 1.871,6.334), and contact history (AOR = 12.24; 95%CI 6.992,28.121) increased the risk of contracting measles infection.

Conclusion: children under 15-year age were more affected groups. The absence of vaccination in the area precipitated by a high rate of malnutrition was the main cause that aggravates the number of new infections. Contact history and malnutrition were the identified risk factors for measles infection. Therefore, increasing immunization coverage of more than 80%, and securing food security decrease the susceptibility of outbreak occurrence.

Background

Measles is a highly contagious, vaccine-preventable viral illness characterized by fever, malaise, rash, cough, Coryza, and conjunctivitis. Initial signs and symptoms typically include fever, often $> 40^{\circ}\text{C}$, cough, runny nose, and red eyes(1). Two or three days after the start of symptoms, small white spots may form inside the mouth known as kopliks spot. A red flat rash which usually starts on the face and then spreads to the rest of the body typically begins three to five days after the start of the symptoms. The complication occurs in about 30% and may include diarrhea, blindness, inflammation of the brain, and pneumonia among others. Infectivity is the greatest three days before rash onset, can also be transmitted four days after onset of rash. Secondary attack rates among susceptible household contacts have been reported to be 75–90%(2, 3).

Eradication is possible because measles has only human reservoir; however, due to social and political factors and high transmissibility, elimination and eradication have been achieved in very few areas of the world(4). Worldwide, measles is a significant cause of morbidity and mortality. Before the introduction of

the measles vaccine, over two million deaths occurred annually, the majority in children < 5 years of age(5). Nine out of ten people who were not immune and share living space with an infected person(6), children too young to be vaccinated or not vaccinated, older age, being female(7), not received a second dose, those for whom the vaccine failed to provoke a protective immune response, travel to areas where measles is endemic(1, 8) having contact history(9) could contract measles infection. The risk of death among those infected is usually 0.2% but probably reached up to 10% in those malnourished peoples(5, 10). In developing countries, the expected Case-Fatality Rate(CFR) is between 3% -5%, but it could be beyond 30% in high-risk populations; like in infants aged less than one year of age(3, 11). The attack rate of the measles outbreak recorded in Ethiopia as nationally was 4.1 per 100,000 populations, in 2008(2). In 2013, 13.4% CFR of the outbreak from brief communication in South Gondar zone, Ethiopia, in 2009(12).

Methods

Study setting and period

Unmatched case-control study design was conducted from September 29/2016 to October 15/2016 in Undufo Kebele (*Kebele: lowest admin level in Ethiopia*), Gewane district, Afar Region, Ethiopia. The district is located 385 Km from Addis Ababa (capital city of Ethiopia) and 222 Km from Semera. The total population of the district is 38,991 as projected from the 2007 national census. There is no Hospital but has three health centers and nine health posts. During the outbreak period, the district was seriously affected by drought and there was a scarcity of safe water for drinking. Hence, the population enforced to use from unsafe open water sources (Awash River and filwuha unprotected spring).

Case definition: A measles positive case was any person who developed any one of the following symptoms; fever, cough, Coryza, red eyes, maculopapular rash or tested IgM positive during the study period(13).

Enrolment of Cases and Controls

Case: Any person who fulfills the case definition given above during the data collection period was included as measles cases.

Control: Any person who did not show any one of the signs from the case definition stated above during the data collection period, and is residents of the district were taken as controls.

Since the vaccination status of the populations in which the outbreak occurred was zero percent, the presence of epidemiological linkages as well as clinical case definitions were used to draw an indication of occurrences. Therefore, it was not compulsory to confirm all cases by laboratory tests. Thus five blood samples were collected from patients and were sent to Ethiopian Public Health Institute for laboratory confirmation.

Data Collection Procedure

House-to-house searching was done to include and manage cases using line list recording. A structured questionnaire was used to collect data from cases and controls. A total of eight questions were asked to assess participants' knowledge about measles. Respondents who scored the mean and above were considered as having "good knowledge", whereas, those scored below mean had "poor knowledge" about measles. The vaccination coverage of the district and moreover Undufo Kebele was taken from the district's annual report.

Data Processing and Analysis

The data were entered using Epi-Info 7.1 and imported to SPSS version 21 for advanced analysis. Results were presented using graphs and tables. Attack rate and case fatality rates calculated. Odds ratio (OR) with a 95% confidence interval was computed to identify factors associated with cases and controls. First, a bi-variable analysis was done for each independent and outcome variables. Here, those variables had a P-value of < 0.2 were fitted to multivariable analysis. In the multivariable logistic regression model, a p-value < 0.05 to identify statistically significant variables and 95%CI of OR to indicate the strength and direction of association were computed.

Ethical Issues

Ethical approval was assured by the University of Gondar, Institute of Public Health, College of Medicine and Health Science Ethical review board. Permission was gained from Afar regional health Bureau to conduct the investigation. Verbal assent from children between 5–18 years of age and verbal consent from the parents were obtained and the information gained were kept confidentially.

Furthermore, each new measles cases were managed as per national guideline for measles surveillance and outbreak investigation, Ethiopia(13). Also, a vaccination campaign was conducted.

Results

Epidemiological characteristics of participants

A total of 50 cases and 100 controls were included in the investigation. Measles cases were reported since September 19/2016 in Undufo health center, Gewane district. Those cases were originally from Ididi and Badawayne areas of Undufo Kebele and they arrived at the area of the outbreak before a month. There were three deaths (CFR = 6%) reported during the study period. Among 50 measles cases, 29(58%) were female. A majority, 27(54%) of 50 cases were in the age category of 5–14, followed, 19(40%) by 1–5 age group. All most all, 47 (94%) of the cases were from Undufo while the remaining 3 of the case were from Den hele area (Table 1). All of the currently affected residents were from Badawayne and Ididi remote areas. These people had migrated to this area before two months because of the scarcity of water and food because of drought. It could be concluded that there was no vaccination activity in the area. Children below five years' age were more affected (Attack Rate = 43.5) followed by 6–15 age group (AR = 15.2) per10,000 populations (Table 2). Overall the attack rate was 19.1per 10,000 population (108 total

cases were recorded until the outbreak controlled over), Of which the attach rate was higher (32.2 per 10,000 populations) among females.

Table 1
Measles cases distribution by different characteristics of respondents,
Undufo Kebele, Gewane District, December 2016

Variable	Case No (%)	Controls No (%)	Total No (%)
Sex			
Male	21(42)	50(50)	71(47.3)
Female	29(58)	50(50)	79(52.7)
Age			
< 1 years	1(2)	6(6.1)	6(4.5)
1–5 years	20(40)	27(27.5)	43(29.4)
5–14 years	27(54)	58(59.2)	90(59)
>=15 years	2(4)	9(9.2)	11(7.1)
Mean(years)	6.5	6.8	
Mode(years)	2	5	
Occupation			
pastoralist	50(100)	100(100)	150(100)
Educational status			
No formal Education	48(96)	99(99)	147(98)
Had formal Education	2(4)	1(1)	3(2)
Knowledge			
Good	6(12)	8(8)	14(9.3)
Poor	44(88)	92(92)	136(90.7)
Vaccination history			
Yes	0	4(4)	4(2.7)
No	50(100)	96(96)	146(97.3)
Contact history			
Yes	35(70)	12(12)	47(31)
No	15(30)	88(88)	103(69)

Table 2
Age and sex specific attack rates of measles infection, Undufo Kebele, Gewane District, Afar region, December 2016

Variables	Population weight	Cases	Attack rate(per 10,000)
Age category in full year			
< 1	1643	1	6
1–5	4363	19	43.5
6–15	18477	28	15.2
> 15	32,284	2	0.6
Sex			
Male	19,145	44	22.3
Female	19,846	64	32.2

The majority of the cases had the date of rash onset on September 30/2016. As shown in Fig. 1, there were multiple peaks; indicating the presence of a high person to person transmission. Five blood samples were collected from five of the suspected cases. The samples were sent to the Ethiopian Public Health Institute, Addis Ababa for confirmation of the outbreak. Four of the five samples were positive for measles IgM.

Clinical presentation of cases

Forty-seven (94%) of 50 cases had a fever, while conjunctivitis Coryza and rash were present in 89%, 75% and 66% of the study subjects, respectively. None of the respondents with the disease had blindness (Table 3).

Table 3
Clinical presentations of Measles cases, Undufo Kebele,
Gewane district, Afar region, December 2016

Sign and symptoms	Frequency(N = 50)	Percent (%)
Conjunctivitis	47	89
Blindness	0	0
Coryza	40	75
Cough	24	45
Fever	50	94
Rash	35	66
Diarrhea	8	15

Factors associated with measles infection

Since the variables were small in number, we analyzed all variables in multivariable logistic regression. Therefore, after adjusting for confounding effects of variables, in the multivariable model, malnutrition (AOR = 3.21; 95%CI 1.871,6.334), and contact history (AOR = 12.24; 95%CI (6.992,28.121) increased the risk of contracting measles infection by 3.21 and 12.24 times more likely than their counterparts respectively. The other independent variables like; vaccination history, age, educational status, occupation, and sex did not have an association with the dependent variable at $\alpha = 0.05$ significance level (Table 4).

Table 4

Bi-variable and multivariable logistic regression analysis of factors associated with measles outbreak, Undufo Kebele, Gewane district, Afar region, Dec 2016

Variable	Case	Controls	COR(95%CI)	AOR(95%CI)
Sex				
Male	21	50	0.72(0.365,1.436)	
Female	29	50	1	
Age				
< 1 years	1	6	0.75(0.055,10.233)	
1–5 years	20	27	3.33(0.646,17.144)	
5–14 years	27	58	2.09(0.423,10.363)	
>=15 years	2	9	1	
Educational status				
No formal Education	48	99	0.24(0.021,2.740)	
Had formal Education	2	1	1	
Knowledge				
Good	6	8	1	
Poor	44	92	0.63(0.208,1.950)	
Contact history				
Yes	35	12	17.11(7.283,40.202)	12.24(6.992,28.121)
No	15	88	1	1
Malnourished				
Yes	31	29	3.99(1.952,8.174)	3.21(1.871,6.334)
No	19	71	1	1

Discussion

This study was interested to identify risk factors and give an appropriate intervention in Undufo Kebele, Gewane district Afar regional state. The outbreak was declared after four from five serum samples were positive for measles IgM antibodies. In the Ethiopian context, the measles outbreak is declared if five measles suspected by a physician or three confirmed by the laboratory at the district level(13). Since the outbreak was local, all other cases were epidemiologically linked to laboratory-confirmed cases. Measles is highly contagious and one index case can produce up to 20 new cases in a community in which the whole is susceptible, and the secondary attack rate can be 75–90%(14). In this investigation, three

measles deaths (CFR = 6%; 95%CI 5.934,6.065%) were recorded, which was higher compared to the expected case fatality rate (3–5%) in developing countries including Ethiopia(13, 15). This might be due to sine this study area was affected by drought, where if the area is deprived by nutrition, the CFR will have reached up to 10%(13). This fatality rate was less than the outbreak investigation report from the South Gondar zone (CFR; 13.4%)(12). This might be due to the regional state, emergency management team deployed by the Federal Ministry of Health and MSF Spain collaborative case management effort in this study. In this study, the attack rate was 191 per 100,000 populations, which was higher compared to study in Tigray regional state in which less than 80 cases per 100,000 populations reported(2). The majority of the cases 32(64%) were in the age category of 5–14, under one population are not affected, which is incomparable with the observations made by other outbreak investigation studies(10, 12). In this study females (58%) were more affected which also incomparable to the Somali refugee camp outbreak response, in which there is no sex difference, but similar to report in the South Gondar zone(2). One of the strategies achieving and maintaining high coverage ($\geq 90\%$ nationally and $\geq 80\%$ in district) are to prevent outbreaks(13). But measles vaccination coverage in Undufo Kebele was zero, even the district's coverage is 70% (Gewane district 2015 annual health report). According to this study finding, there was no association between vaccination and the chance of acquiring measles virus. But Vaccination is known to be the main protective factor against measles (8, 16). This might be no vaccination history of both the case and control groups.

This finding revealed marital status, educational status, religion, occupation, ethnicity, area of living room, knowledge about transmission have no variability among the case and control and no association at $\alpha = .05$, this was incomparable to other studies(8, 11, 16).

Malnourished children were 3.21 times more likely to be affected by measles than children who were not malnourished (AOR = 3.21; 95%CI 1.871,6.334). This was similar to different studies and guidelines, in which malnutrition aggravates acquisition of measles infections (1, 13).

Children who had contact history with other measles cases were 12.24 times more likely infected with measles virus than those children did not have contact history (AOR = 12.24; 95%CI (6.992,28.121), which was similar to other studies(9, 10, 16, 17).

Conclusion

The main potential factors that led to a measles outbreak were the absence of vaccination at the area precipitated by a high rate of malnutrition. The leading causes of the spread of the disease were contact history at the household level, and malnutrition aggravated by the presence of drought in the area. There was no vaccination in the area, therefore, increasing the coverage to more than 80%, and securing the nutritional status of residents will decrease the numbers of susceptible individuals and risk of outbreak occurrence.

Abbreviations

Declarations

Ethics approval and consent to participate

Permission was obtained from university of Gondar, College of Medicine and Health Sciences institute of public health ethical Review board, Afar regional state health bureau and Gewane district health office to investigate the outbreak. We have also obtained verbal consent from each study participants who are 18 and above years age, and for those between 5 to 16 years we taken verbal consent from them and written consent from their parents/guardians. But for the children under 5 years we obtained assent from their parents/guardians according to Ethiopian research ethics guideline.

Consent for publication

Not applicable

Availability of data and materials

Questionnaire used for data collection is available from the corresponding author on reasonable request. All other necessary data are included in the manuscript.

Competing interests

The author declared that there is no competing interest

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Authors contributions

WMA was the author involved in the design, implementation, data collection, analysis and draft the manuscript. Also involved in the evaluation of the manuscript. The author has read and approved the manuscript.

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Figures

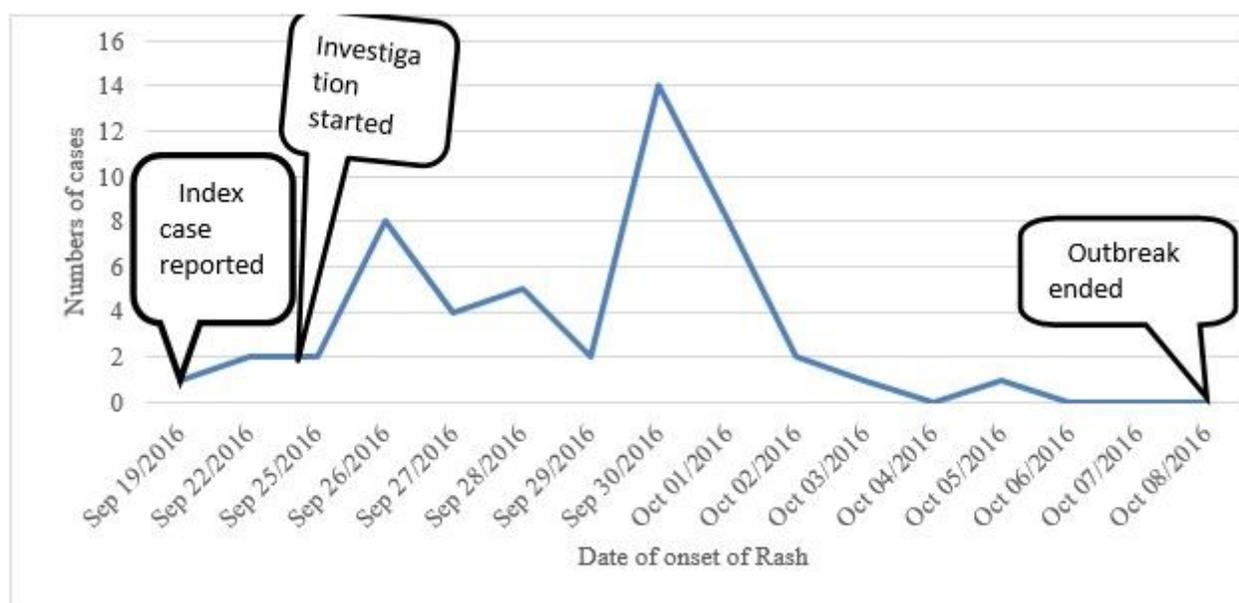


Figure 1

Numbers of Measles cases by date of onset of rash, Undufo Kebele, Gewane District, Afar region, December 2016