

RISK FACTORS ASSOCIATED WITH RUBELLA OUTBREAK IN GONDAR TOWN, NORTHWEST ETHIOPIA

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ABSTRACT

Rubella is a contagious viral disease caused by rubella virus and spreads through fluid from the nose and throat of an infected person. Rubella infected persons are most infectious during the week before and after the appearance of the rash. In Ethiopia, rubella is neither notifiable disease nor among the targeted diseases on Expanded Program on Immunization (EPI). This study aimed to investigate and identify the risk factors of rubella virus outbreak in Gondar Town, Amhara region, Northwest Ethiopia. Unmatched case-control study design was conducted from May, 24-June 7, 2016. A total of 40 cases and 120 controls of children below 15 years were included in the study. Data were collected using a pre-tested structured questionnaire. Data were entered to EpiInfo version 7.0 and analysed using SPSS version 20. Results were interpreted using odds ratio and P value <0.05 and 95% confidence interval were used to determine the significant association. Majority, 25 (63%) of cases and 62 (52%) of control participants were between 5-9 years. Factors such as age < 9 years (OR=2.2, 95% CI: 1.02-4.5), caregivers having at least secondary education (OR=0.31, 95% CI: 0.11-0.85), care givers age between 21-30 year (OR=3.1, 95% CI: 1.2-7.9), and contact with rubella patient (OR=9, 95% CI: 3.8-21.33) were found to have significant association with rubella virus outbreak. The school children were mostly affected by the rubella outbreak. Then, infected children spread into the public through the school children. Contacts with the rubella patient and caregivers' age were found to be independent predictors of the outbreak. Screening and isolation of school age children both at school and home controlled the spread of the outbreak.

Key Words: Rubella outbreak, risk factors, Gondar, Ethiopia

Background

Rubella is an infectious disease caused by a single-stranded ribonucleic acid virus of the family *Togaviridae* and genus *Rubivirus*(1). Rubella virus infection during pregnancy could lead to fetal death or congenital defects called Congenital Rubella Syndrome (CRS), such as heart defects, blindness and deafness. (2). Rubella virus spreads from person to person via respiratory droplets or direct contact and congenitally (3). Individuals with acquired rubella remain infectious seven days before rash onset to 5–7 days thereafter. Infants with congenital rubella syndrome may shed large quantities of viruses from body secretions, particularly from the throat and in the urine, up to one year of age. The rate of transmission is 10-30% but may also vary with the immunization rate of the population (4).

The Centers for Disease Control and Prevention (CDC) reported that a total of 94,030 rubella cases were reported to World Health Organizations (WHO) in 2012 from 174 member states, an 86% decrease from the 670,894 cases reported in 2000 from 102 member states (5). Three of the six WHO regions had set control or elimination targets for rubella. The African and South-East Asia regions have not yet set rubella elimination, control or prevention goals (6).

The surveillance conducted in Ethiopia reported 15.3% were confirmed case for rubella virus and 52.2% were females, and the age of confirmed cases ranged from one month to 42 years. Additionally, the cases were increased from 83 in 2009 to

856 in 2013 but dropped to 222 and 319 in 2014 and 2015 respectively (7).

Ethiopia reported 1,304 laboratories confirmed rubella cases; of which 343 cases were reported from the Amhara Region and seven rubella cases were reported from Gondar town Administration from 2013-2015. Although rubella cases are relatively low in Gondar administration, new cases of rubella increased recently (8). Rubella vaccination has a major role in the prevention of rubella by giving lifetime immunity. In addition, it improves women's health, reduces health inequities and also promotes culture of prevention; however, Ethiopia has not yet implemented a rubella vaccination plan which was supposed to be implemented in between 2012-2020 (9).

In Ethiopia, rubella and congenital rubella syndrome is not a notifiable disease. Moreover, there is no surveillance system designed to capture and report. However, measles case based laboratory surveillance system and the case definition of measles supported the diagnosis and the documentation of rubella cases (7). To better understand and control rubella, there is a need to investigate and identify risk factors associated with rubella virus outbreak in Gondar town administration, Northwest Ethiopia.

Methods

Study Area

Gondar is a city located in the Northwestern part of Ethiopia. It is located at 661 km far from Addis Ababa at a coordinate of 12°36'N 37°28'E and 2,133

meters above sea level. Based on the 2007 national census conducted by the Central Statistical Agency of Ethiopia (CSA) projected population, Gondar town had a total population of 333,432, of whom 163,381 were men and 170,051 women. Additionally, the under one and under five year population were 10,370 and 45,147 respectively. Gondar town had 12 sub-cities, 1 satellite urban kebele¹, and 11 rural kebeles. A total of 51 health facilities were found in Gondar town Administration (1 Governmental Hospital, 8 health centers, 14 health post, 1 private hospital, 26 private clinics, and 1 NGOs clinic). Out of the 51 health facilities, 24 health facilities were providing routine immunization. The primary health coverage in 2015 was 89 % (10).

Study Design and period

Unmatched case-control study design was conducted from 24th May-7th June, 2016.

Study Population

Cases: A case was any resident of MarkieKebele in Gondar town, all (40 cases), who tested positive for IgM or had symptoms of rubella or a clinical diagnosed as rubella during the outbreak period.

Controls: A control was any resident of Markiekebele in Gondar town, all (120 controls), during the study who was a neighbor to a case and who did not develop signs and symptoms of rubella.

Inclusion and Exclusion criteria

Inclusion Criteria

Cases: A case was any resident of Markiekebele in Gondar town all (40

cases), who tested positive for IgM or had symptoms of rubella or a clinical diagnosed as rubella during the outbreak period

Controls: A control was any resident of Markiekebele who was a neighbor to a case and did not develop signs and symptoms of rubella, and agreed to participate in the study.

Exclusion Criteria

Those cases and controls who refused to participate in the study.

Sample size determination sampling procedure

To examine the risk factor of a rubella outbreak in the study area, the required sample size was determined using power approach by using result obtained from another study(11). The sample size was calculated using Epi-info version 7 statistical. The following assumptions were considered while calculating the sample size, 95% of confidence level, 80% power of and 1:3 ratios of cases to controls. But the cases in the study area were only found to be 40. So we took all the case and 120 controls.

As all the cases were included in the sample, whereas for the controls stratified sampling was used. We stratified the kebele into five sections, and then three sections were selected randomly by lottery method. The samples were allocated proportionally to the localities. The final sampling unit was households. The sampling interval of the household in each locality was determined by dividing the total number of the household to allocated sample size. Finally, lottery method was used to select study participants in the selected household

¹The smallest town administration

and we interviewed one control participants in each household. In Households with more than one eligible, the youngest child was taken.

Data Collection

A pre-tested structured questionnaire was used to collect data on factors associated with contracting Rubella, community knowledge and practices on rubella for both cases and controls. The Questionnaire was developed after review of relevant literature and existing questionnaires. As it was an outbreak which needed urgent actions and attention; first face validity was established then experts evaluated whether the questions effectively capture the topic under investigation. Later, a psychometrician checked the questionnaire for common errors like double-barreled, confusing, and leading questions; necessary corrections were made based on the feedback given. Finally it was validated in the study setting. Trained research assistants collected the data. Data collectors were fluent and proficient in Amharic and English respectively and they were translating English into Amharic for study participant during data collection. Initially, suspected children were identified from "EwketBer" School and these children were traced to their home, then data were collected using home visit for each child. Blood samples for six children were sent to Amhara Regional Laboratory assuming the disease as measles. The laboratory result was sent back after two weeks. Consecutively samples were also sent to the regional laboratory for confirmation of cases until

the outbreak managed. Moreover, data were checked for completeness and consistency.

Data Analysis

The collected data were entered into EpiInfo version 7 software and then exported to SPSS version 20 for analysis. Descriptive statistics were used to determine the frequency of different variables. Bivariate and multivariate logistic regression analysis was applied to identify the risk factors of rubella virus infection and outbreak. Odds ratio and confidence interval with 95% confidence limits and significance level ($P < 0.05$). Ethical clearance approved by Ethical committee of the, Institute of Public Health, University of Gondar. An informed verbal consent to take argument was obtained from parents or guardians for all study participants. Participants were treated with respect and willingly participated in the study with no payment. The questionnaire was not including name and address of the participants.

Results

Socio-demographic characteristics of participants

Among all cases, 20(50%) were females and 20 (50%) were males, while among 120 controls, 74 (61.6%) were males and 46(38.3%) were females. The median age of cases & controls were 6 years (Q1=4; Q3=8). The majority of both cases and controls were between 5-9 years, 25 (63%) and 62 (52%), respectively. The median age of care givers was 33 (Q1=30; Q3=36.75) for cases and 35.5 (Q1=30;

Q3=38) for the controls (**Table 1**). All cases of rubella were seen at “Markie” health center, Gondar Town Administration. Six cases were sent to Amhara regional

laboratory for the confirmation of the result, whereas 32 cases were epidemiologically confirmed.

Table 1: Age specific attack rate (ASAR) of rubella cases by their age group, Gondar Town Administration, Amhara Regional state, Northwest Ethiopia, 2016

Age Group	Number of Cases	Total Population	ASAR/100,000 population
< 1	0	1637	0
1_4	12	6469	186
5_9	25	8686	288
10_14	3	7685	39
15_19	0	5369	0
20_24	0	4211	0
25_29	0	4106	0
30_34	0	2685	0
35_39	0	2685	0
40_45+	0	9107	0
Grand Total	40	52,640	76

1. * Source of population size is obtained from Gondar Town Health Office Public Health Emergency Management Case Team and Conversion factor for each age group is from 2007 population and housing census & Ethiopia Demographic and Health Survey 2011.
2. Reference 10. Agency CS, Addis Ababa E, International I, Calverton M, USA. Ethiopia Demographic and Health Survey 2011. March 2012. p. 19_20.

The Epi-curve shows several peaks suggesting a propagated outbreak. The outbreak was detected at the health facility level on 24th May, 2016. There was a sharp increase of cases to a peak of 8 cases on the 27th May, 2016. Cases steeply declined to zero on 3rd June and spiked to 2 cases on the 29th May, 2016 (**Figure 1**).

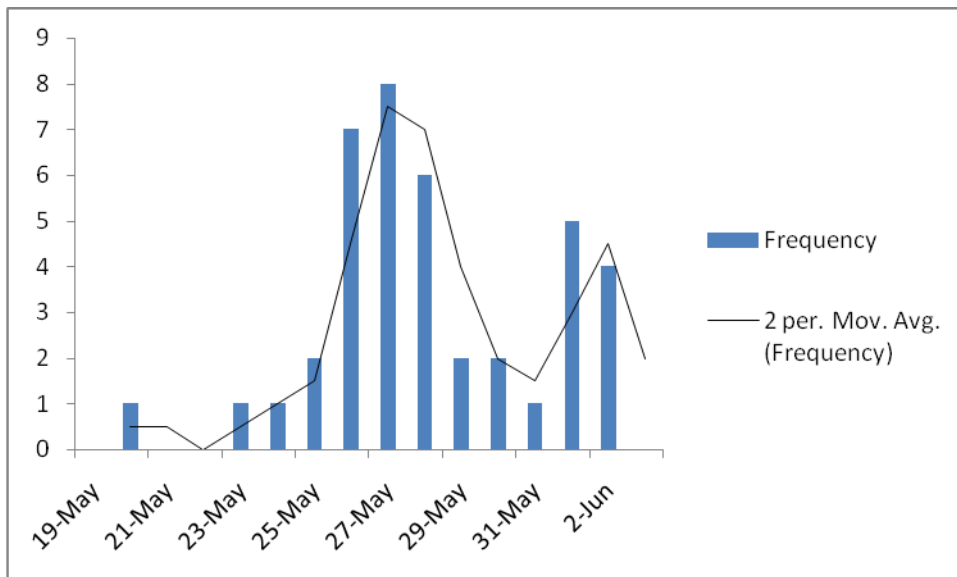


Figure 1 Cases of Rubella Outbreak by date of onset, Gonder town, Norwest Ethiopia, 2016

The Age Specific Attack Rate (ASAR) was highest in school-aged children between 5-9 years (288 per 100,000 population) followed by 1–4 years (186 per 100,000 population) and least in adults aged between 10-14 years (39 per 100, 000 populations) (Table 2).

Table 2: Demographic characteristics of study participant Gondar town administration, Amhara Regional state, Northwest Ethiopia, 2016

No	Characteristics	Cases (count/%)	Control (count/%)
1	Sex of children	Male	74(62%)
		Female	46(38%)
2	Age of children	1-9 years	52(43.3%)
		10-15 years	68(57.7%)
3	Age of caregiver	21-30	41(34.2%)
		31-35	32(26.7%)
		36 and above	47(39.2%)
4	Family size	≤4	59(49.2%)
		≥ 5	61(50.8%)
5	Educational status of children	Under school	45(37.5%)
		Primary	75(62.5%)
6	Educational status of caregiver	Primary and below	82(68.3%)
		Secondary and above	38(31.7%)

7	median age of children	6(Q1=4, Q3=8)	6(Q1=4, Q3=8)
8	median age of caregiver	33(Q1=30, Q3=36.75)	35.5(Q1=30, Q3=38)

Factors associated with rubella outbreak

Participants whose age was 9 years or less were 2.2 times (OR=2.2, 95% CI: 1.02-4.5) more likely to contract rubella virus compared to those between the ages of 10-15 years.

Caregivers who attended at least secondary education prevented the rubella virus outbreak by 69% as to compared those who attended primary

education and below (OR=0.31, 95% CI: 0.11-0.85). On the other hand, care givers aged between 21-30 years were three times (OR=3.1, 95% CI: 1.2-7.9) more likely increased the outbreak compared to care givers aged between ≥36 years. The presence of contact with rubella patients were nine times (OR=9, 95% CI: 3.8-21.33) more likely increased rubella outbreak (**Table 3**).

Table 3: Factors associated with contracting rubella in Gondar Town Administration, Amhara Regional state, Northwest Ethiopia 2016

Factories (variables)		Respondent Status		COR	95% CI	P-value
	Category	Case 40(%)	Control 120(%)			
Age of Child	1-9	25 (32.5)	52 (67.5)	1.	1	.
	10-15	15 (18.5)	68 (81.9)	2.2	1.02-4.5	P=0.004
Caregiver level of education	Primary and lower	35 (29.9)	82 (70.1)	0.31	0.11-0.85	.P=0.025
	Secondary and above	5 (11.6)	38 (88.4)	1	1	
Age of caregiver	21-30	7 (14.6)	41 (85.4)	3.1	(1.2-7.9)	P=0.02
	31-35	8 (20)	32 (80)	2.1	(0.9-5.3)	P=0.11
	≥36	25 (34.7)	47 (65.3)	1		
Family size	≤4	26 (30.6)	59 (69.4)	0.521	(0.248-1.094)	P=0.085
	≥5	14(18.7)	61(81.3)	1	1	
Presence of contact with rubella patients	No	8 (8.8)	83 (91.2)	9	3.8-21.33	P<0.001
	Yes	32 (46.4)	37 (53.6)	1		
Caregiver knowledge of known Preventive Methods	No	30 (21.1)	112 (78.9)	0.214	(0.078-0.59)	P=0.00
	Yes	10(55.6)	8(44.4)	1.0		
Sex of child	Male	20 (21.3)	74 (78.72)	0.622	(0.302-1.278)	P=0.196
	Female	20 (30.3)	76 (69.7)	1	1	

In this study, two factors were found to be independent predictors for contracting rubella; those who had contact with rubella patients were 12 times more likely for contracting rubella as compared to non-contacted ones (AOR= 12.6, 95% CI: 4.6-33.9). In addition, care givers' age was an independent predictor (**Table 4**).

Table 4: Independent factors for contracting Rubella in Gondar Town Administration, Amhara Regional state, north-west Ethiopia 2016

Independent Factors		Respondent status		COR(95%CI)	AOR(95%CI)	P-Value
		Case (No/%)	Controls (no/%)			
Presence of contact with Rubella patients	No	8(8.8%)	83(91.2%)	9(3.8-21.33)	12.6(4.6-33.9)	P<0.0001
	Yes	32(46.4%)	37(53.6%)	1	1	
Age of Caregiver	21-30	7(14.6%)	41(85.4%)	3.1(1.2-7.9)	7(2.2-22)	P=0.001
	31-35	8(20%)	32(80%)	2.1(0.9-5.3)	4.9(5.6-15.7)	P=0.006
	≥36	25(34.7%)	47(65.3%)	1	1	

Discussions

The epidemic curve had several peaks typical of a propagated outbreak, suggesting person to person transmission of the rubella virus. The index case which was also the primary case had the onset of rash on the 20th May, 2016 and where reported to have been in contact with a "suspected measles" case. This suggests that, the occurrence came from "Bemba-Sefere" and spread within the

school then into the community through school children.

In this finding high risk of contracting rubella virus was seen among child less than nine years. The finding is consistent with the epidemiology of rubella virus cases in the pre-vaccination era of Ethiopia, 2009–2015 which showed that three-fourth of all confirmed rubella cases were aged less than 10 years (7). This finding is also consistent with CDC reports global progress toward rubella and Congenital

Rubella Syndrome Control and Elimination (5). The low occurrence of rubella virus infection among older children is likely due to natural infection and development of immunity against rubella at earlier ages and different levels of susceptibility in these age groups.

Results emanating from the present study showed that children's caregivers who attained at least a minimum of secondary education were likely to prevent the rubella virus outbreak by 69%. This study corroborates a study conducted in Sinana District, Southeast Ethiopia showed that the incidence of vaccine preventable diseases reduced as care givers educational status increases (12). It is also consistent with a study conducted in Gokwe North district, Zimbabwe (13). This might be related to the fact that being educated has significant role in health seeking behavior and disease prevention. This may have a positive impact on prevention of the outbreak and early diagnosis and management of the diseases.

In this study, children who had a history of contact with rubella infected patient were nine times more likely to develop rubella disease as compared to those who had no history of contact. Moreover, it was found out that school children with rubella continued attending school. This could be one the reasons for the rapid spread of the disease among the school children through sneezing and coughing. This finding was biologically plausible considering that Rubella spreads through respiratory secretions. A similar finding was reported in a study conducted in rural communities in Kenya and Zimbabwe in 2014 (11, 14). The evidence

showed that children who contracted rubella from school might spread the disease to their siblings at home and as well as to their neighbors. This implies that isolation at home could stop the spread of rubella to those children who were not attending school. However, children continued to attend school thereby spread the disease to other children in the school and community members..

The age of care givers was found to be significantly associated with rubella infection. Children of younger care givers were three times more likely to develop rubella infection compared to those children having older mothers or care givers. This might be explained by the fact that older mothers or care givers were better experienced to care for their children; whereas young caregivers may not know the importance of quarantining sick children both at home and at school. This finding is consistent with South Korean government Infant Care Act (15).

Ethiopia like many other African countries does not currently provide Rubella-Containing Vaccine (RCV) within the national immunization program, and a surveillance system for congenital rubella syndrome does not currently exist. Therefore, this study has provided critical information on the presence of rubella disease in Ethiopia as an outbreak which implies the necessity of introducing RCV and surveillance system for congenital rubella syndrome considering the WHO policy on rubella vaccination which currently recommends combining measles and rubella control strategies and planning efforts which focus on the widespread use of measles-rubella vaccine (6).

There was a possibility that controls could have been infected with rubella viruses but that might not be showed signs and symptoms of rubella during the investigation. This could have introduced ascertainment bias which might have reduced the strength of associations; the median age for both cases and controls were 6 years. Caregivers perceived the rubella illness as measles and they were knowledgeable on measles which has some similar risk factors and signs and symptoms with rubella. Although the study tried to show some form of association it did not exactly identify risk factors.

Conclusion

The school children between the ages of 5 - 9 years were most affected by rubella in Gondar town administration. The outbreak was driven by contact at school and was spread into the community through school children. Screening and isolation of learners both at school and home could have controlled the spread of the outbreak. The presence of rubella disease in Ethiopia as an outbreak implies the necessity of introducing RCV and surveillance system for congenital rubella syndrome. The health administrations of the study area should sensitize health workers, urban health extension workers, school teachers, school children, care givers and the community at large. Moreover, ways should be in place for active case finding, isolation of cases in the community as well as for health education sessions in the health center, schools, and community.

Abbreviations

ASAR: Age Specific Attack Rate, AOR:

Adjusted Odds Ratio, CI: Confidence Interval, CRS: Congenital Rubella Syndrome, MMR: Measles Mumps Rubella, OR: Odds Ratio RCV: Rubella-Containing Vaccine

Declarations

Ethical approval

Ethical clearance approved by Ethical committee of the, Institute of Public Health, University of Gondar. A formal letter was written by the University of Gondar to North Gondar zonal health department, Gondar town health office and "Maraki" health center in order to obtain approval for data collection. An informed verbal consent to take argument was obtained from parents or guardians for all study participants. Participants were treated with respect and willingly participated in the study with no payment. The questionnaire was not including name and address of the participants.

Consent to publish

The requirement to obtain consent for publication was waived by University of Gondar IRB.

Availability of data and materials

Relevant data are within the manuscript. All data can be made available upon request by the corresponding author.

Competing interests

The authors declare no competing of interest.

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Authors' contributions

All authors contributed equally. All the authors read and approved the final

manuscript.

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