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Risk Factors for Measles Outbreak: An Unmatched Case Control Study in Kabridahar District, Somali Regional State, Ethiopia

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Abstract **Background:** Measles is a highly contagious, serious respiratory viral disease characterized by fever, and maculopapular erythematous rash. Before widespread vaccination in 1980, measles was responsible for an estimated 2.6 million deaths worldwide each year. **Objective:** of this study was to investigate the magnitude of measles outbreak and identify factors that contributed its incidence in Kabridahar District. **Methods:** A descriptive and unmatched case control study for 33 cases and 66 controls was conducted in Kabridahar district. Structured questionnaire was used for data collection from cases and controls. Data was analyzed by using Microsoft excel and SPSS 20. **Result:** A total of 33 cases and 66 controls were recruited for this outbreak investigation data collection. The overall attack rate was 0.4/1,000 with zero case fatality. From the total cases, 17 (51%) were male and 16 (49%) were female. 18 (55%) out of the total cases were reported from the age group 5-14 years. 13 (39%) from the total 33 cases were reported from Elhar kebele, 7 km from Kabridahar town. The mean age of cases and controls were 7.6±4.6 SD and 7.5±4.8 SD respectively. 20 (61) of the cases and 16 (24%) of the controls didn't ever receive vaccination for measles. Cases that had contact history with another confirmed measles case (AOR=3.5, 95% CI (5.9, 21.4)); presence of measles case (s) in the neighboring household and or within the household (AOR=14.5, 95% (3.0, 7.0)) and (AOR=9.5, 95% CI (1.8, 4.8)) respectively and not vaccinating children from measles virus (AOR=5.6, 95% CI (1.3, 2.4)) were significantly associated with the outbreak. **Conclusion:** History of contact with measles case (s), presence of case (s) in the neighboring household and or within the household and not vaccinating children timely were independent risk factors for this outbreak.

Keywords: *measles, outbreak, investigation, risk factor, Somali Region*

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1. Introduction

Measles is an acute, highly contagious viral disease caused by measles virus in the family Paramyxovirus, genus Morbillivirus, transmitted primarily by respiratory droplets or airborne spray from the coughs and sneezes of person infected with the disease to mucous membranes in the upper respiratory tract or the conjunctiva [1]. It is one of the most infectious diseases of the human which can cause serious illness, lifelong complication and death [2]. Symptoms of measles include fever, cough, coryza, conjunctivitis and generalized maculopopular erythematous rash [3]. Measles infection can result in serious complications such as blindness, encephalitis, or severe respiratory infections such as pneumonia [4].

Important measures are underway to achieve measles elimination in Europe, the Eastern Mediterranean, and the Western Pacific regions by 2015, and the African region by 2020. Achieving these elimination goals will have direct benefits in the United States. In 2001, countries in the World Health Organization (WHO) African Region began accelerated measles control activities to reduce measles deaths by half by 2005 compared to the estimated number of measles deaths in 1999. Implementation of the recommended strategies led to a 75% reduction in estimated measles mortality in the African Region by 2005. Following this progress, in 2006 the African Region adopted a goal to achieve 90% measles mortality reduction by 2010 compared with the estimate for 2000. In 2008, the African Region reported measles cases decreased 93% and estimated measles mortality decreased 92% compared with 2000 [4].

Outbreak preparedness and response is one of the five core strategies in the 2012–2020 WHO strategic plans for global measles and rubella. The other strategies include improving routine vaccination coverage, providing a second opportunity for measles vaccination through supplementary immunization activities (SIAs), improving measles-case management, and establishing case-based measles surveillance [3].

Since 2002, Ethiopia adopted these regional goals and strategies and has been taking important steps to control measles. The National Immunization Programme was established in the 1980s, and currently delivers service through static and outreach sites nationwide. The current routine immunization schedules recommend a dose of measles vaccination at 9 months of age. The WHO UNICEF coverage estimates for measles vaccination for Ethiopia also indicate an increase from 37 % in 2000 to around 80% in 2010 [5].

Despite tremendous achievements towards global measles mortality reduction and measles elimination goals, in 2010, there were 327,305 measles cases reported and an estimated 139,300 measles deaths globally (i.e., approximately 380 deaths/day) [6]. During 2009-2010, measles outbreaks were reported in Europe, Africa and Asia [7]. In 2010–2011, Western Europe saw a rise in measles cases with at least 33 countries reporting more than 68,743 measles cases, resulting in importations into the Americas [8]. In countries where measles has been eliminated, cases imported from other countries remain an important source of infection.

Measles outbreaks are still very common in Ethiopia. In 2014, wide spread outbreaks accounting 16,028 cases were reported from the nine regional states and two administrative cities. In 2015/2016, Somali Regional State of Ethiopia has experienced explosive outbreaks of measles throughout the region. Notably, measles outbreaks were ongoing for several months in districts/towns like Degahbur and Kabridahar. The aim of this study was to investigate the magnitude of measles outbreak and identify factors that contributed its incidence in Kabridahar District, Somali Regional State, Ethiopia, 2016.

2. Methodology

2.1. Study Area and Period

The study was undertaken in Kabridahar district and Kabridahar Administration Council of Korahe Zone, Somali Regional State of Ethiopia from March to April, 2016. Korahe Zone consists of five districts named as: Kabridahar, Dobowein, Shilabo, Sheygosh and Marsin with an overall estimated population of 312,713 [9]. The zone borders with four other regional zones and Somalia in the south east. Kabridahar town is the administrative headquarters of the Zone which lies 370 km from Jijiga, the Regional capital, in the south. Kabridahar district remains the largest district both in population and geographical location. There is one general hospital in Kabridahar, two health centers in nearby Kebeles (smallest administrative unit) called Dalat and Galadiid and a number of health posts both in the town as well as in rural areas.

2.2. Study Design and Sampling Procedure

An Unmatched, 1:2 case-control study was employed to investigate the outbreak. Cases were selected by simple random sampling from the outbreak line list, whereas controls were the next neighbors of cases by considering age similarities.

2.3. Data Collection Technique

Data was collected referring back registration log books, case based reports, line lists and surveillance data that were available at both Kabridahar Hospital and district health office. Moreover, parents/care givers were interviewed by using structured questionnaire on their children's behalf.

2.4. Data Processing and Analysis

Data was cleaned and then, analyzed by using Microsoft Excel 2013 and SPSS 20. Descriptive analysis of the disease by person, place and time was done by depicting this in graphs, charts and or tables. Then, bivariate analysis of main outbreak presumed factors was performed by considering factors' crude odds ratios with a 95% CI which didn't include 1 in its upper and lower limits to be significantly associated with measles outbreak. Factors which showed significant associations in bivariate analysis were proceeded for multivariate analysis to identify independent predictors of measles in Kabridahar district by considering factors' adjusted odds ratios with 95% CI as in bivariate analysis.

2.5. Inclusion and Exclusion Criteria

Any person with generalized maculopapular rash lasting ≥3 days; with temperature ≥101°F or 38.3°C; and cough, coryza, or conjunctivitis and neighbors of those suspected cases who did not develop signs and symptoms of measles were legible to be included in the study as cases or controls respectively. Cases and controls with mental disabilities or couldn't speak properly and with no surrogates on their behalf were excluded from the study.

3. Results

3.1. Distribution of Cases by Person

A total of 33 measles cases, with an overall attack rate (AR) of 0.4/1,000 population were reported from 16 March to 19 April, 2016. From the total cases, 17 (51%) were male and the rest 16 (49%) were female. The mean age of cases was 7.6 years or in other words, the most affected age group was the 5 to 14 years old children with no reported death. From the 16 (49%) mothers and 17 (51%) fathers interviewed on behalf of their children, 9 (56%) of the mothers were housewives and whereas, 8 (47%) of the fathers were pastoralists. Twenty one (64%) of the study participants didn't ever attend formal education and 12 (36%) completed either elementary or junior schools.

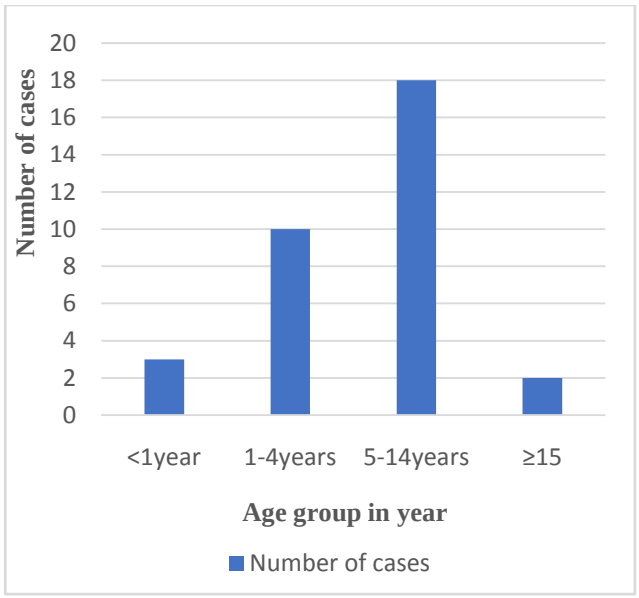

Figure 1. Measles case distribution by person, Kabridahar district, Korahey zone, Somali region, Ethiopia, April 2016

3.2. Vaccination Status of Measles Cases

Majority of cases, 20 (61%) hadn't taken vaccination against measles virus; 7 (21%) had taken one dose of measles vaccine; 3 (9%) of the cases had taken two doses and the vaccination status of 3 (9%) cases was unknown.

3.3. Distribution of Cases by Place

The first (index case) was reported from Kabridahar City Administration but later on cases were reported from seven rural kebeles under Kebridahar district. The highest number of cases, 13 (39.40%) were reported from Elhar Kebele, 7km away from Kabridahar Town.

3.4. Distribution of Measles Cases by Time

The index case was a 1.5 year old male child in 02 Kebele of Kabridahar City Administration with an onset of signs and symptoms on 29th December 2015, then the outbreak continued in a propagative fashion and the investigation began on mid-April 2016 (Figure 2).

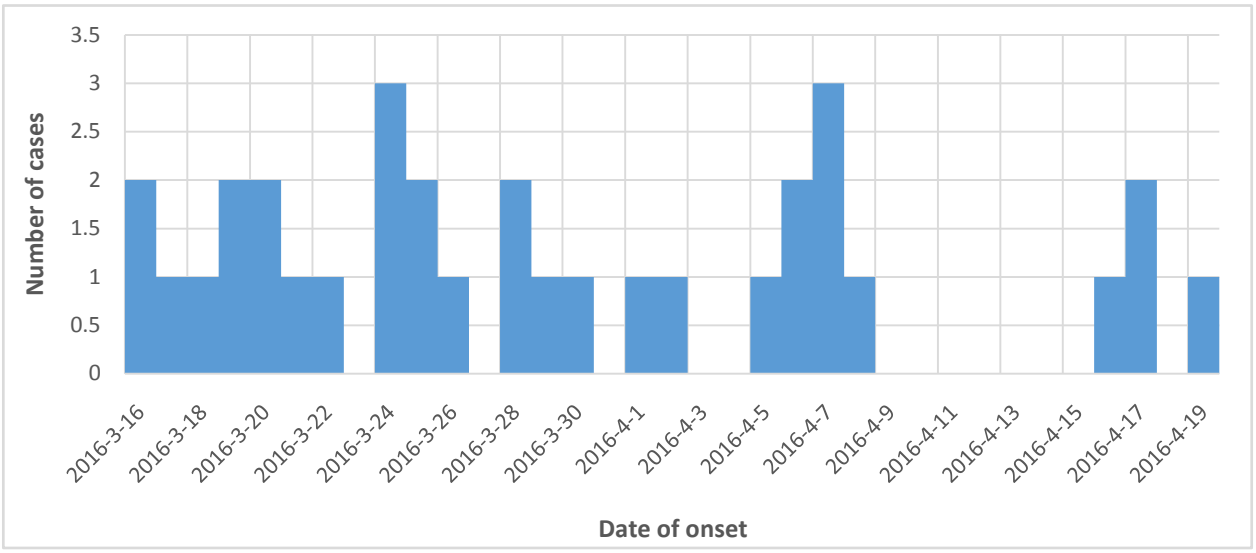

Figure 2. Distribution of measles cases by date of onset, Kabridahar distric, Korahey zone, Somali Regional State, Ethiopia 2016

3.5. Analytical Investigation

Table 1. Demographic characteristics of measles cases and controls, Kabridahar District, Korahey Zone, Somali Region, Ethiopia, 2016

Demographic characteristic		Cases (33)	Controls (66)
Age group			
	<5 years	16 (48.5%)	25(39.4%)
	5-14 years	18(55%)	37(56%)
	≥15 years	2(6%)	6(9%)
Sex	F	16(49%)	35(53%)
	M	17(51%)	31(47%)
Education background	No formal education:	21(63.6%)	38(57.6%)
Parents	Formal education	12(36.4%)	28(42.4%)
Marital status	Married	26 (78.8%)	58 (87.9%)
	Single	3 (9.1%)	5 (7.6%)
	Widowed/divorced	4 (12.1%)	3 (4.5%)
Occupation	Housewife	9 (27.3%)	27 (40.9%)
	Pastoralist	8 (24.2%)	19 (28.8%)
	Employee	6 (18.2%)	7 (10.6%)
	Others	10 (30.3%)	13 (19.7%)

In bivariate analysis of the presumed outbreak risk factors, contact with another confirmed case in the 7 to 18 days preceding the eruption of rash (COR=19.4, 95% CI (6.6, 57)), measles case in the neighboring household (COR=14.1, 95% CI (5.1, 38.7), measles cases within the household (COR=12.7, 95% CI (4.6, 34.6)) and vaccination status (COR=6.3, 95% CI (2.4, 16.1)) were significantly associated with measles outbreak (Table 2).

Further multivariate analysis was undertaken for factors that have significant associations with the disease in bivariate analysis to controls possible confounders and find out independent predictors. Contact history with another measles case (AOR=3.5, 95% CI (5.9, 21.4)), Not vaccinated children (AOR=5.6, 95% CI (1.3, 2.4)), Measles case in the neighboring household (AOR=14.5 95% CI (3, 7.0)), and measles case within the household (AOR=9.5, 95% CI (1.8, 4.8)) remained to be independent predictors of this measles outbreak (Table 3).

Table 2. Bivariate analysis of presumed risk factors of measles outbreak in Kabridahar District, Somali Region, Ethiopia, 2016

Variable		Case (n=33)	Control (n=66)	COR	95% CI
Age of the respondent					
<5 years		16 (48.5%)	25 (39.4%)	1.8	(0.3, 10.3)
5-14 years		15 (45.5%)	35 (51.5%)	1.3	(0.24, 7.3)
≥15 years		2 (6.1%)	6 (9.1%)	1	
Sex	Male	17 (51.5%)	31 (47%)	1	
	Female	16 (48.5%)	35 (53%)	1.2	(0.5, 2.76)
Education background	No formal education	21 (63.6%)	38 (57.6%)	1.29	(0.55, 3.0)
	Formal education	12 (36.4%)	28 (42.4%)	1	
Marital status					
Married		26 (78.8%)	58 (87.9%)	1	
Single		3 (9.1%)	5 (7.6%)	1.3	(0.29, 6.0)
Widowed/divorced		4 (12.1%)	3 (4.5%)	2.97	(0.6, 14.3)
Occupation	Housewife	9 (27.3%)	27 (40.9%)	1	
	Pastoralist	8 (24.2%)	19 (28.8%)	1.26	(0.4, 3.86)
	Employee	6 (18.2%)	7 (10.6%)	2.57	(0.68, 9.68)
	Others	10 (30.3%)	13 (19.7%)	2.3	(0.76, 7.1)
Travel history	Yes	9 (27.3%)	23 (34.8%)	0.7	(0.28, 1.76)
	No	24 (72.7%)	43 (65.2%)	1	
Contact history	Yes	23 (69.7%)	7 (10.6%)	19.4	(6.6, 57)*
	No	10 (30.3%)	59 (89.4%)	1	
Vaccination status	Vaccinated	10 (33.3%)	50 (75.8%)	1	
	Not vaccinated	20 (66.7%)	16 (24.2%)	6.3	(2.4, 16.1)*
Measles case in the neighboring household	Yes	25 (75.8%)	12 (18.2%)	14.1	(5.1, 38.7)*
	No	8 (24.2%)	54 (81.8%)	1	
Measles case in the household	Yes	19 (57.6%)	13 (19.7%)	12.7	(4.6, 34.6)*
	No	14 (42.4%)	53 (80.3%)	1	
Household size	≤6	13 (39.4%)	24 (36.4%)	1	
	>6	20 (60.6%)	42 (63.6%)	0.88	(0.37, 2.1)
Reason for not vaccinating children	DGVS**	15 (45.5%)	29 (43.9%)	1	
	DKWGVS***	18 (54.5%)	37 (56.1%)	0.9	(0.4, 2.2)

*significant association at P value <0.05; **DGS: Didn't Get Vaccination Service; DKWGVS: Didn't Know Where to Get Vaccination Service; COR: Crude Odds Ratio, CI: Confidence Interval; 1: Reference factor.

Table 3. Independent predictors of measles outbreak in Kabridahar District, Korahey Zone, Somali Regional State, Ethiopia, 2016

Variable		Case (n=33)	Control (n=66)	COR	AOR	95% CI
Contact history	Yes	23 (69.7%)	7 (10.6%)	19.4	3.5	(5.9, 21.4)*
	No	10 (30.3%)	59 (89.4%)	1		
Vaccination status	Vaccinated	10 (33.3%)	50 (75.8%)	1		
	Not vaccinated	20 (66.7%)	16 (24.2%)	6.3	5.6	(1.3, 2.4)*
Measles case in the	Yes	25 (75.8%)	12 (18.2%)	14.1	14.5	(3.0, 7.0)*
neighboring household	No	8 (24.2%)	54 (81.8%)	1		
Measles case in the	Yes	19 (57.6%)	13 (19.7%)	12.7	9.5	(1.8, 4.8)*
household	No	14 (42.4%)	53 (80.3%)	1		

*significant association at p value <0.05; 1: Reference factor/variable; COR: Crude Odds Ratio; AOR: Adjusted Odds Ratio.

4. Discussion

The overall attack rate (AR) among measles cases was 0.4 per 1,000 people with zero case fatality (CF). This may be due to early case management activities in Kabridahar hospital. The most affected age group was 5-14 years, 18 (55%) of cases were reported from this age group. This should be epidemiological shift of measles transmission from under five years to above five years age group due to immunization priorities which are directed to the first. According to the residential areas, 13 (39%) cases were reported from Elhar kebele, some 7km away from Kabridahar town. The reason for this could be that the kebele has permanent water sources for pastoralists and its residents as well, as a result there are large number of pastoralists moving to and out of the area which can propel transmission of the disease. From the total, 21 (61%) of the cases and 38 (58%) of the controls didn't attend formal education in their life. This was due to the fact that these parents were residing in rural kebeles were formal education coverage is still very low.

Majority, 20 (61%) of cases didn't ever receive vaccination against measles virus. This finding is closer with the findings of measles outbreak investigation conducted in Guji Zone of Oromia Regional State, in which 95.3% of the cases were reported not to have had taken measles vaccination [10]. Cases that had contact history with another confirmed measles case (s) have 3.5 times more risk of contracting the disease at 95% CI of (5.9, 21.4) than those with no contact history. This is due to the nature of this disease transmission by respiratory droplets or airborne spray in close case contacts. Another related findings were the presence of case (s) in the neighboring household and within the household. In the first, cases have had 14.5 times more chance to contract the disease than controls with a 95% CI of (3.0, 7.0) and in the later one, cases were 9.5 times more susceptible to develop measles than controls with a 95% CI of (1.8, 4.8). On their vaccination status, cases who didn't ever get vaccination were 5.6 times more likely to develop measles disease with a 95% CI of (1.3, 2.4) than those who got vaccinated so far. This clearly depicts that measles disease is vaccine preventable.

5. Conclusion

Measles outbreak in Kabridahar district has affected almost all the nearby rural Kebeles and the Kabridahar City Administration. History of contact with another confirmed measles case (s), presence of case (s) in the neighboring household and within the household and not vaccinating children timely were predictors of measles outbreak in Kabridahar district.

6. Recommendations

Based on the key findings in this study, Kabridahar District Health Office in collaboration with the Regional Health Bureau and other concerned partners and stakeholders should improve and strengthening routine immunization throughout the zone; undertake Supplementary Immunization Activities (SIAs) in target areas; establish strong district surveillance system and advocate childhood vaccination/immunization by undertaking regular community based health education campaigns.

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Conflict of Interests

There is no conflict of interests between authors.

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