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Epidemiological Investigation of Measles Outbreaks in Somalia: A Retrospective Study

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Background: Measles has been a significant and persistent public health challenge in Somalia, with frequent outbreaks reported across the country, which is grappling with a complex humanitarian crisis, decades of political instability, and recurrent natural disasters. This study aimed to assess the epidemiology of measles by examining the affected individuals' outcomes, laboratory results, and demographic characteristics.

Methods: We conducted a retrospective study analyzing measles cases reported to the National Public Health Reference Laboratory across various states in Somalia, from January to June 2024. We then employed rigorous data analysis using SPSS version 26.

Results: Of the 1266 suspected measles cases received at the laboratory, 58.4% were confirmed as measles positive. The highest attack rate was observed in children under 1 year old, with 133 cases per 100,000 individuals. Males accounted for 57.4% of the cases, with an attack rate of 155 cases per 100,000 individuals. Overall, 98.3% of the cases were unvaccinated individuals. The highest number of cases was reported in the states of Banadir, Hirshabelle, and Galmudug, accounting for 32.6%, 20.5%, and 19.6%, respectively. The sex of the children was statistically associated with measles (p-value = 0.026), while age was also statistically significant (p-value = 0.001).

Conclusion and Recommendations: These findings indicate a significant measles outbreak, particularly among unvaccinated individuals, with children under 1 year old being the most vulnerable. Males showed a higher attack rate compared to females. To mitigate future outbreaks, health authorities should focus on intensifying vaccination campaigns in the most affected regions and age groups. Strengthening healthcare infrastructure and raising public awareness about the importance of vaccination are also essential to prevent future outbreaks and improve public health.

Keywords: epidemiology, measles, outbreaks, public health, Somalia

Introduction

Measles is an infectious disease caused by Morbillivirus, a member of the Paramyxoviridae family. It is transmitted through respiratory droplets from an infected individual via coughing or sneezing. The most contagious period occurs during the 5 days following the onset of the rash. This period may be extended due to the presence of the virus in urine, blood, nasopharyngeal mucosa, and the oral cavity, with increased contagiousness resulting from the virus's development in the respiratory system.[1]

According to the World Health Organization (WHO), measles immunization has prevented 56 million deaths globally between 2000 and 2021. Despite, the availability of a safe and affordable vaccine, measles remains a significant public health issue, with an estimated 2021 by 128,000 measles-related deaths worldwide.[2] In 2019, measles outbreaks occurred across the Lao People's Democratic Republic (Lao PDR), with the first confirmed case reported in January in the northwest. Additional cases emerged a month later in the central region, and the disease rapidly spread throughout the country.[3]

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In Ethiopia, the age group targeted for outbreak response and immunization efforts at the onset of measles outbreaks did not align with the number of cases among unvaccinated adolescents and adults in newly displaced populations.[4] On the other hand, Ethiopia aims to achieve 80% basic immunization coverage, including the measles vaccine, in each district. This was carried out through a primary healthcare system consisting of five health posts and one health center, serving a population of 25,000, with each health post serving 5000 residents. In addition to regular vaccination clinics, the Ethiopian government has implemented an outreach immunization strategy, particularly for remote areas. Kasoshekumer is a rural kebele where agriculture is the primary livelihood.[5] In 2002, Kenya introduced a case-based surveillance system for measles, which involved completing a case report form and conducting a blood test for measles IgM on each suspected measles patient visiting a health facility. An outbreak is suspected if five or more cases are reported per 100,000 people in the same health area within a month. If three out of five specimens test positive, the outbreak is confirmed.[6]

Meanwhile, Somalia faces a climate-related public health crisis exacerbated by internal conflicts, economic instability, and institutional weaknesses. The country is particularly vulnerable, grappling with the aftermath of devastating droughts, sudden floods, and recurring disease epidemics, including measles and cholera.[7] Measles remains widespread in Somalia, with significant annual variability in case numbers. According to the District Health Information Software (DHIS2) report from 2018 to 2022, the overall coverage for the first dose of the Measles-Containing Vaccine (MCV1) was 67.7%, while the second dose (MCV2) coverage was only 3.3%.[8] Complications of measles include pneumonia, tracheitis, diarrhea, otitis media, encephalitis, and subacute sclerosing panencephalitis. These complications disproportionately affect infants, adults over 20, pregnant women, and individuals who are immunocompromised or malnourished, particularly children with vitamin A deficiency.[9] In 2000, measles was a leading cause of vaccine-preventable childhood mortality, with an estimated global death toll of 535,000. By 2017, the estimated annual mortality from measles had decreased to approximately 110,000.[10] For example, between July 9 and October 31, 2011, the Dollo-Ado area on the Ethiopia–Somalia border reported 407 measles cases and 23 fatalities, resulting in a 5.6% case fatality rate. Among the confirmed cases, 55.3% were female, 44.7% male, and 43.7% were aged 15 or older. All five tested cases showed the presence of measles-specific IgM antibodies.[11]

Another study in Somalia found that the pooled mean case fatality rate for measles was 2.2%, with an in-hospital death rate averaging 2.9%, ranging from 0.9% to 6.0%.[12] Measles is endemic in Somalia and remains a significant public health concern. The country faces numerous challenges, including limited healthcare access, insufficient public health knowledge among parents, vaccine hesitancy, low immunization coverage, scarce healthcare resources, poor infrastructure, and a fragile health system. To address these challenges, improving immunization coverage is crucial. A key strategy is to research vaccine hesitancy, as understanding its root causes will provide valuable insights for addressing low immunization rates and contribute to the solution.[13] This study aims to assess the epidemiology of measles by examining outcomes, laboratory results, and the demographic characteristics of those affected.

Methods

Study Site and Design

This study utilized a retrospective design to analyze suspected measles cases reported to the National Public Health Reference Laboratory located in Mogadishu, Somalia, dedicated to advancing public health through rigorous scientific research and surveillance across various states in Somalia.

Study Population

The study population included 1266 suspected cases of measles with symptoms, reported during the study period. These cases were drawn from seven states, in Somalia. These are including Southwest, Galmudug, Puntland, Hirshabelle, Jubbaland, Benadir Regional Administration, and Somaliland. The cases were identified based on the presence of symptoms such as fever and rash and were reported to the National Public Health Reference Laboratory in Mogadishu, Somalia, for further analysis, from January 2024 to June 2024.

Data Collection

Data were collected from the National Public Health Reference Laboratory records, which documented each suspected measles case. The dataset included variables such as age in years, gender, number of measles vaccination doses received, presence of fever and rash, type of biological specimen collected, measles IgM laboratory results, case classification lab-confirmed or discarded, and the final health outcome.

Data Analysis

The data were imported into IBM SPSS Statistics software for analysis. Descriptive statistics were used to summarize demographic characteristics, vaccination status, symptoms, laboratory results, and outcomes. The distribution of cases across different states and months was also analyzed. The attack rate was calculated and defined as the proportion of suspected measles cases that were confirmed out of the total population at risk within the defined areas during the study period. Chi-square tests were employed to assess associations between categorical variables, such as gender and measles IgM results, or vaccination status and case classification, and were used to identify factors associated with laboratory-confirmed measles cases and adverse outcomes.

Laboratory Analysis

Laboratory confirmation of suspected measles cases was performed using enzyme-linked immunosorbent assay (ELISA) to detect measles-specific IgM antibodies. The testing was conducted using the EUROIMMUN Anti-Measles Virus IgM reagents on an automated platform to enhance efficiency and accuracy cases that tested positive for measles IgM were classified as laboratory-confirmed measles cases, while those with negative results were classified as discarded cases. Rubella IgM testing was also conducted to differentiate rubella from measles where necessary.

Ethical Considerations

Our study was approved by the National Institute of Health, Somalia, before it started. Since we conducted a retrospective study analyzing anonymized data of measles cases reported to the National Public Health Reference Laboratory across various states in Somalia, individual patient consent was not required according to the ethical guidelines of the National Institute of Health, Somalia. All data were anonymized and handled with strict confidentiality to ensure privacy was protected.

Results

Of the 1266 suspected measles cases received at the laboratory, 58.4% were confirmed as measles positive. The highest attack rate was observed in children under 1 year old, with 133 cases per 100,000 individuals. Males accounted for 57.4% of the cases, with an attack rate of 155 cases per 100,000 individuals. More than 98.3% of the cases were in unvaccinated individuals. The highest number of cases was reported in the states of Banadir, Hirshabelle, and Galmudug, accounting for 32.6%, 20.5%, and 19.6%, respectively.

Therefore, all variables were analyzed at the bivariate level. The sex of the children was statistically associated with measles (p-value = 0.026), while age was also statistically significant (p-value = 0.001). Infants under 1 year were at higher risk of contracting the measles virus if unvaccinated. Regarding vaccination status, unvaccinated study participants were strongly associated with measles (p-value = 0.001), with a 40.8% higher chance of exposure to the paramyxovirus. Additionally, the six states of the federal government of Somalia were correlated with measles (p-value = 0.001), with an 87.7% higher likelihood of having measles. Benadir, however, was the epicenter of the measles outbreak, as shown in Table 1.

This shows the number of measles cases reported for each age group.

Infants under 1 year are most vulnerable to measles due to their immature immune systems and lack of vaccination. Children under 4 years of age are also at higher risk, as they may not yet be vaccinated. Also, children over five are generally more protected, either through vaccination or prior infection as Figure 1 illustrates the distribution of cases by age group.

Table 1 Sociodemographic Characteristics of the Participants Based on IgM Serological Essay (n = 1266)

Variables	+/n	95% CI	P value
Sex			
Male	405/727	0.210–0.213	0.026
Female	334/539	1.0 −11.3	
Age Group (in Year)			
<1	355/479	11.1–25.7	< 0.001
1–4	217/366	16.3–21.1	
5–15	144/329	12.8–14.3	
>15	23/92	12.0–18.5	
Vaccination Status			
Vaccinated	19/22	11.4–13.9	< 0.001
Non-vaccinated	508/1244	10.8–17.2	
States			
Banadir	362/413	27.7–38.0	< 0.001
Hirshabelle	189/260	22.7–23.6	
Galmudug	31/248	12.5–13.4	
South west	55/184	19.9–22.3	
Jubbaland	61/92	20.3–33.2	
Puntland	36/51	20.6–32.3	
Somaliland	5/18	08.8 −10.8	

This study found that clinical symptoms, including coryza, were observed in children, with a significant (p-value = 0.029). Children under five-year old were more likely to be exposed to the measles virus, with a susceptibility rate of 59.3%. Additionally, conjunctivitis was statistically significant in relation to measles, with a (p-value= 0.007). Other symptoms, such as fever, rash, cough, and conjunctivitis, were also reported during the case investigation, as shown in Table 2-.

Discussions

This study revealed a strong correlation between measles outbreaks and unvaccinated children across all federal member states in Somalia. This finding aligns with other studies linking recurrent measles outbreaks among children under five to low immunization coverage. A notable example is the Somali American community, which experienced the largest measles outbreak in Minnesota in nearly 30 years. In this outbreak, 58 cases were reported within a single month, with 14 hospitalizations. The study found that nearly all cases occurred in unvaccinated children, primarily within the 32,000-strong Somali American community in Minneapolis.[14] On the other hand, similar study highlighted the prevalence of comparable symptoms in unvaccinated individuals, emphasizing the urgent need for enhanced immunization efforts. Most participants exhibited fever, rash, cough, and conjunctivitis, with only 39.1% of them vaccinated. In this study, the in-hospital mortality rate was found to be 1.8%, lower than the 2.9% average reported in other studies, possibly due to improved healthcare or early intervention in Somalia.[15]

Our study also found that age was statistically associated with measles (p-value = 0.001), with children under 1 year being at higher risk of contracting the virus if unvaccinated. These findings are consistent with a dataset analyzing measles outbreaks

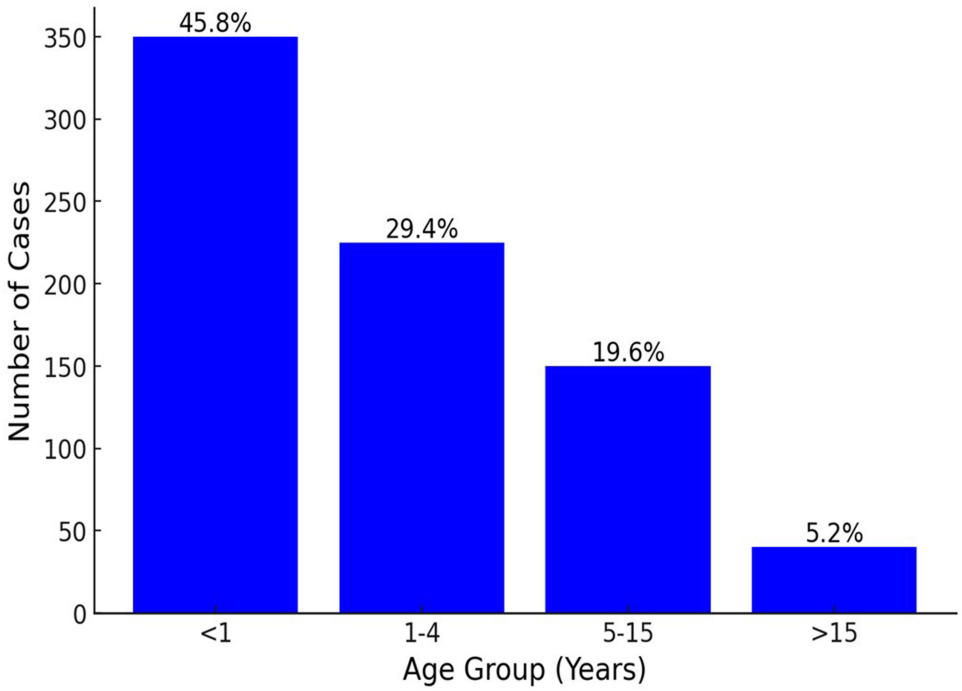

Figure 1 Number of measles cases reported for each group.

in 46 African countries between 1990 and 2018, which showed higher infection rates in younger children and a correlation between increased measles prevalence and higher rates of other diseases and mortality.[16]

In Ethiopia, the initial outbreak response immunization efforts did not align with the number of cases among unvaccinated adolescents and adults in newly displaced populations.[17] Among 1266 suspected measles cases sent to the laboratory, 58.4% were confirmed. The highest attack rate was found in children under 1 year old, with 133 cases per 100,000 individuals. Males constituted 57.4% of the cases, with an attack rate of 155 cases per 100,000. A significant 98.3% of the cases occurred in unvaccinated individuals, contributing to the ongoing measles outbreak. The states with the highest number of reported cases were Banadir (32.6%), Hirshabelle (20.5%), and Galmudug (19.6%), which aligns with studies by Enitan et al.[18]

Common measles clinical features identified in the study included high fever, cough, coryza, conjunctivitis, and Koplik spots, with or without a maculopapular rash. The patients' complications, severity, and vaccination status were further analyzed.[5] This study found that children with coryza had a statistically significant association with measles, particularly in those under five, with a susceptibility rate of 59.3%. Also, other symptoms such as fever, rash, cough, and conjunctivitis were reported during the case investigation. Furthermore, recent study reported that factors like monthly family income were associated with measles immunization status.[12] Severe measles complications, including blindness, encephalitis, severe diarrhea with dehydration, ear infections, and pneumonia, are more common in specific age groups, especially in vulnerable populations.[1]

Table 2 Clinical Manifestations

Variables	+/n	95% CI	P value
Fever	739/1266	12.4 15.9	0.416
Rash	738/1266	11.3–14.1	0.574
Cough	527/1263	10.7–13.2	0.674
Conjunctivitis	676/1179	13.3–16.5	0.007
Coryza	683/1151	15.3–18.2	0.029

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Measles remains endemic in Somalia, with limited awareness of its transmission. From 2000 to 2016, reported cases declined by 85%, from 853,479 to 132,490, with a corresponding 88% reduction in incidence. However, in 2019, cases surged to 837,922, representing a more than fivefold increase compared to 2016. The number of cases decreased to 123,171 in 2021, but rose by 67% to 205,153 in 2022, with incidence increasing by 71%, from 17 to 29 cases per million, 15 the 2017 Minnesota outbreak highlights the significance of addressing vaccine hesitancy in specific communities, such as the Somali population, where vaccination coverage dropped to 42% among Somali 2-year-olds, resulting in severe outbreaks.[6] Similarly, measles vaccine coverage remains suboptimal among Somali immigrant communities worldwide, including in Norway, where Somali children had significantly lower vaccination coverage compared to the national average, exposing them to a higher risk of outbreaks.[4] Moreover, severe measles complications, such as pneumonia, blindness, and encephalitis, have been observed in Somali refugees displaced by famine in Kenya. These challenges underscore the complex epidemiological patterns seen in displaced and conflict-affected populations.[7] Addressing these challenges, including vaccine hesitancy and inadequate healthcare infrastructure, is crucial for reducing the burden of measles and its associated complications in vulnerable populations.[18]

Conclusion and Recommendations

This study highlights a significant measles outbreak in Somalia, particularly affecting children under 1 year old of age and predominantly unvaccinated individuals. To mitigate future outbreaks, it is recommended that health authorities prioritize and intensify vaccination campaigns, especially targeting the most affected age groups and regions. Additionally, strengthening the healthcare infrastructure and increasing public awareness about the importance of vaccination are crucial steps to mitigate the impact of measles and improve overall public health outcomes in the country.

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Disclosure

The authors report no conflicts of interest in this work.

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