ORIGINAL ARTICLE

Clinical Laboratory Investigations of Measles Virus Infection among Symptomatic Patients in South Central Somalia

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Abstract

Background: The number of measles cases among fully vaccinated individuals is still higher than expected because of vaccination. A retrospective cohort study was performed in this population using data collected over the course of 2 years – from January 2020 to December 2021 – to provide a detailed epidemiological and laboratory description of measles infections in symptomatic patients presenting to health care facilities throughout Somalia. **Methods:** In these patients, demographic information (e.g., age, sex, place of residence, available health care center type, socio-economic status, past history of infections, etc.) and clinical characteristics were pulled from their respective medical records for further analyses. **Results:** Of all patients tested for measles, 1180 were positive (61.1% males; 38.9% females), with infants <1 year of age/children <15 years accounting for a majority (85%) of cases. Banadir had the highest prevalence of reported cases (n = 808, 68%), while the lowest were seen in the Galgaduud and Middle Shebelle provinces. Districts with the highest reporting rates were Daynile (*n* = 142, 12.0%), while the lowest were Moqokori (0.01%). Overall, 71.5% of the total population had detectable immunoglobulin (Ig)G or IgM antibodies present. Various indicators and characteristics (fever, skin rash, etc.) were analyzed for all individuals in this study, and were 100% positive. The infant morbidity rate has been reported at 0.10%. **Conclusion:** This report finds that measles is more prevalent among infants/domestic populations primarily due to decreased immune system capability, inadequacy to current vaccination programs, poor hygiene conditions, nutritional deficiencies, lack of medical access/facilities, and lack of knowledge about infectious diseases.

Key words: Epidemic, epidemiology, pediatric infections, viral infections

INTRODUCTION

Measles is found in about 40 million people/year, with over half occurring in Africa, causing 10% of early childhood mortality. There are approximately 2013 deaths due to measles in Africa between early 2018 and early 2019. There needs to be proper epidemiological evaluations and vaccination implementations. In unimmunized and immunocompromised populations, the measles virus typically has a 90% secondary attack rate. Measles is caused by the paramyxovirus and is transmitted through close personal contacts. Rashes and fever generally appear within 10 days after initial infection and can lead to blindness, encephalopathy, or severe respiratory bacterial pneumonia.

To stop the transmission of an infectious disease, such as measles, populations must achieve high levels of immunity; therefore, the population density and number of human immunodeficiency virus-1-infected individuals will create hurdles to eradicating measles. Due to increased vaccination coverage and the widespread use of supplemental vaccination campaigns, many countries with few resources, especially those in Sub-Saharan Africa, have seen significant declines

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in the incidence and mortality from measles. New vaccines that can stimulate the immune system at a very early age and do not require needles/syringes will facilitate neonatal and infant immunization.

Immunization is the only way to prevent measles in developing nations.[1-7] Measles is a leading cause of child morbidity and mortality.[9] A proper vaccination plan will eradicate measles.[10,11] The inability of the additional vaccine administered at later ages (10 through 24 years) has resulted in the continuation of measles outbreaks despite a decrease of 85% in mortality.[8] For this reason, several countries now give school-aged children a third dose of the vaccine. The incidence of measles among children in Somalia has decreased; however, older populations are experiencing continued outbreaks. This is possibly related to refugee populations from places like Afghanistan and Pakistan, where vaccination levels are below 80%, the global average.[12]

Even though there has been no research center-based information in Somalia, the clinical signs and symptoms seen suggest that measles remains a major viral disease in children in Somalia. The present study was undertaken to determine the incidence of measles in various regions of South-Central Somalia to gather information about the current measles epidemiology in these provinces.

MATERIALS AND METHODS

Study design, area, and period

The current retrospective cohort study was conducted from January 2020 to December 2021. The data was collected from different public sector hospitals in south-central Somalia. An institutional ethical approval was obtained before starting the study.

Sample collection

The data of a total of 1180 patients were retrieved from different hospitals and healthcare centers in South Central Somalia. Sociodemographic characteristics (age, gender, residence, etc.) of studied patients were noted along with the clinical and diagnostic profile.

Anti-measles virus immunoglobulin (Ig)M antibodies method

The EUROIMMUN-enzyme-linked immunosorbent assay kit contains a semi-quantitative test for measuring the levels of human IgM antibody to the nucleoproteins of the measles virus.[13] The reagents are the same as those that will be analyzed at the end of case 1. In each microtiter, there are break-outs with 8 recombinant measles virus nucleoproteins. Specimens from patients' blood samples containing sera were incubated and added to wells. Patient sera with positive samples showed distinct IgM antibodies (as well as IgA and IgG) against the antigens used. To distinguish between bound antibodies, a co-incubation step was done with a conjugated protein (enzyme conjugated anti-human IgM) to each antigen generating a colorimetric response.

Calibrators, positive controls, negative controls, and patient samples were added to each microplate by pipetting into the well according to the instructions provided with the test. Following the addition of the samples, the microplates were incubated at 18–25°C for 30 min before they were read.

After performing several washes with the reagent wells, use 300 µL of your working wash buffer to perform multiple washes for each well. Each wash should be performed multiple times using a working wash buffer of 450 µL per wash added to the reagent wells. Each wash of the reagent well should be maintained with wash buffer in that well for 30–60 s; then each well should be drained again. After performing the wash steps outlined above and emptying out all the liquid sample buffers/reagents from each well, you will want to remove all the liquid from the micro plate by tapping it on a piece of filter paper to allow the filter paper to wick off any remaining samples/reagents in the micro plate area before beginning to perform any further sample analysis on the micro plate samples.

Should Free Wells on Microplate Strip be Filled with Clear Wells from the Same Plate Type as the Analyte to be Tested? Add 10 uL of Pipette Enzyme conjugate (Anti-hu IgM conjugated to horse radish peroxidase) to each of the Microplate Wells and Incubate for 30 min. at + 18–25°C, then Aspirate off and Wash as outlined above.

Add to each of the wells of the microplate using a pipette 100 µL of (chromogen/substrate) solution. Incubate for 15 min at room temperature (+18°C–+25°C) away from direct sunlight. Using the same pipette technique and speed as used to add (chromogen/substrate), add to each of the wells 100 µL of stop solution.

Photometric estimation of the variety force ought to be made at a frequency of (450 nm) and a reference frequency between (620 nm and 650 nm) in something like (30 min) of adding the stop arrangement. Before estimating, somewhat shake the microplate to guarantee a homogeneous conveyance of the arrangement.[14]

Statistical analysis

The obtained data were transferred to the data sheet of Statistical Package for the Social Sciences (version 2.0) and Microsoft Excel sheet for the interpretation and analysis of variables or Data to find out the mean (M), standard deviation

(SD), and Pearson coefficient relationship. A $P < 0.05$ was considered as statistically significant.

RESULTS

Sociodemographic characteristics of the study participants

Age and gender association

A total of 1180 patients were recruited in the study, in which 61.1% were males, while 38.9% were females. Males group were highly infected due to outdoor activities, females were less infected due to less education of measles, lack of awareness of measles, and lack of prevention of the measles. The predominance of measles in the age group of 0–5 was 72.6%, 6–10 (10.0%), 11–15 (2.88%), 16–20 (1.18%), 21–25 (0.33%), and 26–30 was (0.42%) respectively.

Measles infection pattern

All infected patients were suffered from fever (100%) as well as with appearance of rashes (100%), while at the end of infection recovery, 99.9% patients become recovered. About 0.10% of deaths were reported in infants (less than month) due to an immature immune status [Figure 1].

Frequency of measles based on provinces patents outpatient department (OPD) in basic healthcare hospitals of the provinces, such as Lower Juba 237 (20%), Lower Shebelle 53 (5%), M Shebelle 13 (1%), Mudug 18 (2%), Bay 21 (2%), Galgadud 15 (1%), Middle Shebelle 15 (1%), while Banadir had 808 (68%) [Figure 2].

Frequency of measles based on districts

We recorded different prevalence of measles from different district of the Somalia such as, 2 (0.1%), wadajir 70 (5.93%), Kahda 25 (2.11%), Daynile 142 (12.0%), Alaziz 5 (0.42%), Adado 10 (0.84%), Afgoe 55 (4.66%), Aliyale 1 (0.01%), Badhaadhe 3 (0.25%), Badoa 9 (0.76%), Baide 9 (0.76%), Balc ad 1 (0.08%), Bondhere 3 (0.25%), Bulaburde 1 (0.08%), Daynile 8 (0.67%), Dharkenley 49 (4.11%), Dhobleey 20 (1.69%), Daynile 103 (8.72%), Galkio 6 (0.50%), H. Jajab 10 (0.84%), Hamar weyn 1 (0.08%), Hawl 1 (0.08%), Wadaag 1 (0.08%), Heliwa 36 (2.97%), Hodann 69 (5.84%), Howlwadaag 15 (1.27%), Jamame 3 (0.25%), Jowhar 1 (0.08%), Karaan 2 (0.1%), Kahada 1 (0.08%), Kaaraan 41 (3.47%), Kismayo 126 (10.67%), Moqokori 2 (0.01%), N/A 5 (0.04%), Raaskaamboni 16 (1.35%), Shangani 9 (0.76%), Shibis 32 (2.71%), Waaberi 1 (0.08%), Wabari 2 (0.1%), Waberi 17 (1.44%), Wadajir 70 (2.11%), Wartanbada 25 (2.11%), and Yaqshid 76 (6.44%). The overall Mean Variance, and SD were calculated against the prevalence of district such as (Mean = 24.6, V = 1175.4, SD = 48193.21), with probability between −1 and 1 is 0.002 [Figure 3].

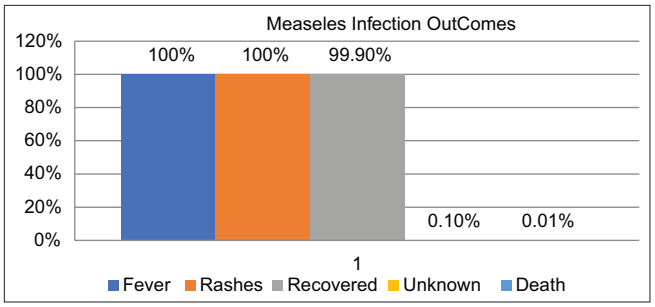

Figure 1: Infection pattern measles infection

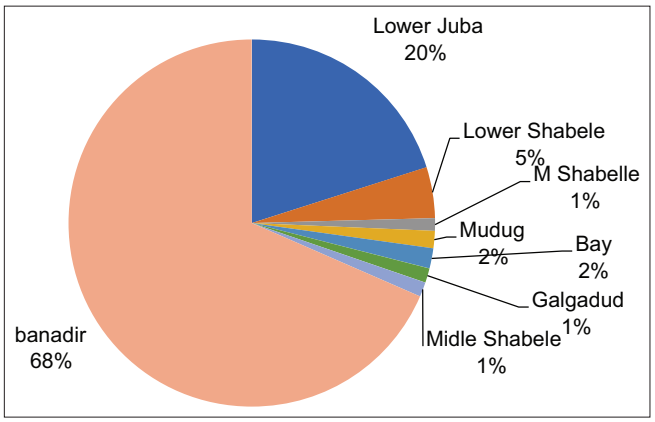

Figure 2: The province-wise prevalence of measles

Frequency of measles based on basic healthcare centers

We recorded different frequencies of measles in enrolled patients from various basic health centres such asA/aziz Health Center 8, Adado Hospital 13, Affgo General Hospital 10, Banadir 628, Bayhaw Hospital 38, Cancen Worldwide 9, Daynile Hospital 24, Dhobleey Referal Hospital 19, Hamarweyne MCH 24, Kismayo General Hospital 132, MCH Hamarweyne 11, Raaskaamboni Health Center 16, N/A(unauthorized/private) 7, Shangani Hospital 16, Shibis Health Center 18, SOS Hospital 201, and Waberi Health Center 8.

Measles clinical detection and confirmation by EUROIMMUN

We recorded different prevalence of Measles in clinically diagnosed (0.25%), Measles Lab-confirmed (85.8%), and Discarded Case was (8.47%), while IgM positive was (71.5%) and negative were (7.96%) from confirmed patients [Figure 4].

Specimen receiving and reported back expanded program immunization (EPI)

From December 1st, 2021, to December 31st, 2021, Somalia healthcare center received patients with specimens for measles antibody/antigen detection and confirmation. The number of specimens received each month: 83 in January, 105 in February, 57 in March, 79 in April, 130 in May, 91 in June, 13 in July, 01 in August, 57 in September, 105 in

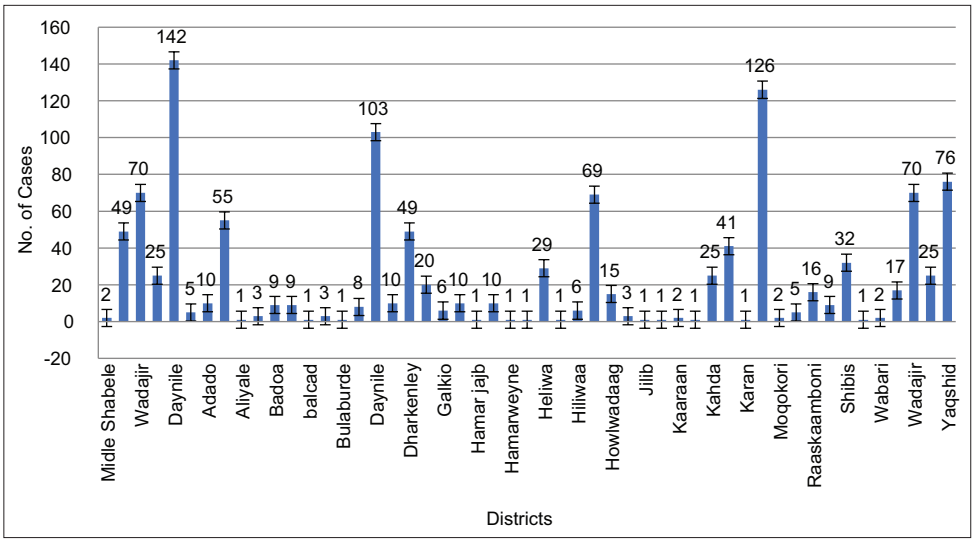

Figure 3: District-wise frequency of positive cases of measles

October, 130 in November, and December was reported as zero. For 2020, the total number of specimens/month was: 26 in January, 29 in February, 09 in March, 0 in April, May, June, and July, 01 in August, 09 in September, 13 in October, 25 in November, and 26 in December.

During 2021, the Somalia EPI department was reported with positive measles cases. Given below are all of the samples reported: 90 (January), 72 (February), 55 (March), 17 (April), 85 (May), 17 (June), 167 (July), 59 (August), 115 (September), 0 (October), 129 (November), and 0 (December).[14] In contrast, during 2020, the Somalia EPI department received positive measles cases. The following total of samples was reported: 26 (January), 29 (February), 41 (March), 9 (April), 0 (May), 0 (June), 0 (July), 1 (August), 9 (September), 13 (October), 25 (November), and 26 (December).[14]

Frequency of onset of rashes

The healthcare centers of the Somalia were evaluated dissimilar frequency of onset of measles rashes during the 2020 and 2021 from different provinces or districts. In 2020, patients got treatment of the measles, such as 31 patients treated in January, 30 in February, 29 in March, 07 in April, 16 in September, and 15 in October, whereas May, June, July, and August recorded as none of measles (no treated patients of measles). The healthcare centers of the Somalia were claimed January, and February as highly effected period. Whereas the dissimilar frequency of onset of measles rashes during year of 2021 was evaluated, like, 136 measles rash outbreaks were recorded across the healthcare facilities of Somalia in 2020 and 2021 as a result of variations in the number of confirmed cases. Before the recorded outbreaks in Somalia, measles was treated on a consistent basis. There were differences across provinces (districts) of healthcare centers, but they were still evaluated at different frequencies. Treatments were recorded for January through April and for September through October of 2020, with 30 measles patients treated in February 2020 and

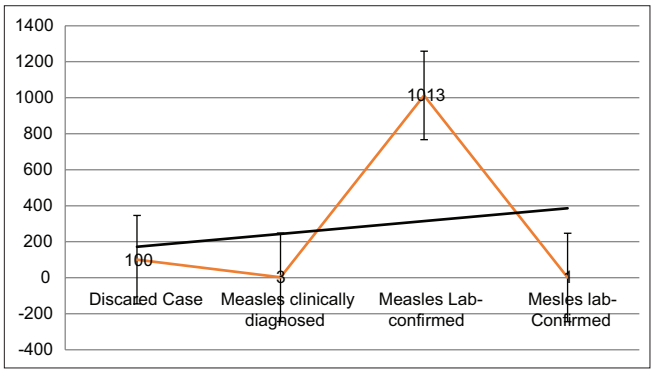

Figure 4: Clinical confirmed positive measles cases

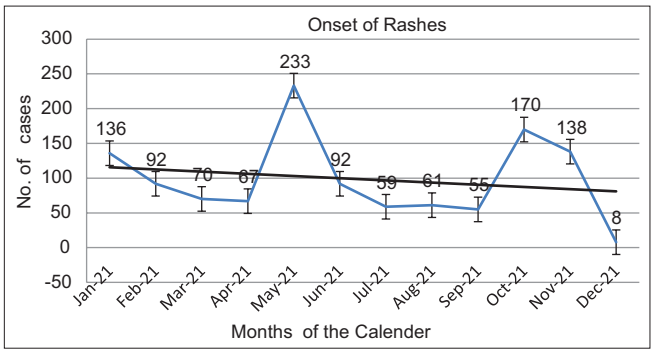

Figure 5: Monthly frequency of rashes onsets of measles

15 in October 2020. No measles patients were recorded during the months of May through August, as not being treated. The frequency of measles patients treated at healthcare facilities of Somalia for 2021 found; January = 136 patients, February = 92, March = 70, April = 67, May = 233 (major peak), June = 92, July = 59, August = 61, September = 55, and October = 170. According to the data collected from Somalia healthcare facilities, the period of January 2021 is considered to have had the highest incidence of measles (136 patients treated), while February 2021 is considered to have had 92 patients treated of measles, and October 2021 (170 treated Patients) [Figure 5].

Patients treated in January, 92 in February, 70 in March, 67 in April, 233 in May, 92 in June, 59 in July, 61 in August, 55 in September, and 170 in October. The healthcare centers of the Somalia were claimed highly affected month was January, with 136patient treated for measles, 92 in February, and 170 in October [Figure 5].

DISCUSSION

A total of 1180 patients who were previously registered in OPD in Basic Health Care Hospitals in the following provinces were included in the study: Lower Juba: 237 (20%), Lower Shebelle: 53 (5%), M Shebelle: 13 (1%), Mudug: 18 (2%), Bay: 21 (2%), Galgadud: 15 (1%), Middle Shebelle: 15 (1%). The majority (808) of patients came from Banadir (68%).

The research showed that the age category 0–5 years old had a higher incidence rate than any other age group to acquire measles[1-7] (72.6%), which was due to a combination of factors such as: having a high number of infants and young children, being immunocompromised (weakened immune system), not receiving enough vaccinations, having immature organs, not having proper hygiene, being malnourished, and being in close contact with others. In addition, this age group was subject to edema and skin rashes throughout their bodies. The younger population group aged 21–25 years of age had a low incidence of measles (0.33%) because they practiced good hygiene and maintained their vaccinations, so that they had developed immunity against the disease.[9]

We have assessed the prevalence of Measles in the districts of Bulaburde (0.08% clinically diagnosed; 100% lab confirmed), Balcad (0.08% clinically diagnosed; 84% lab confirmed), Aliyale (0.01% clinically diagnosed; 100% lab confirmed), Moqokori (0.01% clinically diagnosed; 100% lab confirmed) and N/A (0.04% clinically diagnosed; 0% lab confirmed). There is a significant association between the reported cases of Measles and several contributing factors including high population density with inadequate living conditions, unsanitary living environments, low access to health care, limited access to vaccination facilities, low socioeconomic status, limited vaccination campaigns and low literacy levels, and a high incidence of measles (85.8% lab confirmed vs. 0.25% clinically diagnosed).

We noted that more patients were enrolled at Banadir than at the other 628 hospitals combined due to the availability of advanced treatment facilities (e.g., fully furnished buildings), state-of-the-art structures, a knowledgeable and well-trained workforce, and the presence of facilities capable of handling measles cases. The districts of Daynile and Wadjir lag far behind in their level of development when compared to others. Reporting differences, the distribution of disease, and the number of centers reporting will all cause variations in prevalence. Most patients used facilities such as N/A (unlicensed/private), Aziz 8, and Waberi 8 to obtain treatment for measles, with a few patients being admitted and experiencing limited access to quality medical assist.

The study was carried out in Bulo Bacte from July 31 through August 10, 2019. All households in Bulo Bacte were contacted in order to determine how many births, deaths, and how many are living there at present. This was the time period used for obtaining estimates for the purposes of this evaluation. The study then looked at the number of deaths due to measles (360) that were reported during the 177-day evaluation; 186 of those (52%) were from children under age five. During the entire evaluation, the crude death rate was 0.8/10,000 people, and the under-5 death rate was 1.8/10,000 people. The authors statement with regards to that evaluation's population living there and having high rates of mortality and having health problems indicates that a number of humanitarian, government agencies and non-governmental organizations did not provide sufficient assistance to this population for them obtain safe shelter and or basic resources to support their well-being, and therefore prevented them from obtaining their safe shelter as well as many basic goods and services necessary for maintaining their standard of living, leading to multiple outbreaks of diseases such as measles and illnesses that lasted prolonged periods of time between when they were registered and when they were provided with vaccinations according to Jama *et al*.[15]

In this study, all patients with measles who had fever and rash at onset of measles infection had completely recovered at the end of their infection period. There were very few reported patients who had measles and presented with a rash during 2020, thus lowering the reported incidence of measles cases. This was due to insufficiency in the detection of measles and the lack of funding to facilitate increased detection of measles by healthcare centers in 2020. The increased incidence of measles in 2021 was due to an increase in the number of reported cases of measles during the time of the study, which resulted in improved patient detection and treatment, and the increased funding of healthcare facilities by the state. Furthermore, Somalia's population continued to grow due to its high fertility rate, which led to an increase in the number of patients with measles.

The highest number of measles cases in Banadir were among patients with severe illness (68%) as a result of the high population density, poor literacy rate, poverty, lack of education, poor hygiene and sanitation, few vaccination centers, and lack of knowledge about how diseases/infections are transmitted. The second most affected region was Lower Juba (20% of cases), followed by Lower Shebelle (5%), M Shebelle (1%), Mudug (2%), Bay (2%), Galgadud (1%), and Middle Shebelle (1%).

The purpose of this study is to identify the etiologies of febrile illness in children during a non-epidemic period of measles at a Somali hospital. Measles virus-specific IgM and

IgG were identified in sera from 23 Somali children with febrile infections (i.e., febrile illnesses) and 23 age-matched controls. Approximately 35% of all febrile infections in this population had an identifiable viral etiology detected serologically.[13] Children who were hospitalized for febrile illnesses with a rash are often thought to be cracked one center for this reason; however, there are many other viral causes of febrile illness in children, distinguished from, but must also be included in a differential diagnosis for these children.[16]

During the month of May 2021, there were 130 specimens received by the laboratory healthcare center where 85 tested with (+) positivity for measles IgM Ab, indicating the presence of clinical signs/symptoms for measles. There were 105 specimens received in the month of October where 13 were reported as negative and having a false positive rate, which is significantly high, and were also not sensitive or specific for measles IgM testing. In February 2020, there were 29 specimens received by the laboratory healthcare center, and 26 tested (+) positive for measles IgM Ab.

After the measles reconnaissance data analysis, descriptive studies were conducted 5 years later in the Fafan zone of the Somali region. A total of 332 measles cases were diagnosed. Of those diagnosed, 296 (89%) were epidemiologically linked to the measles cases; 23 (6.9%) were laboratory-confirmed measles cases; 7 (2.1%) were clinically-diagnosed measles cases, and 6 cases (1.8%) were not diagnosed; thus, IgM-negative cases of measles. Of the total measles cases, 79 (23.8%) were not vaccinated against measles; 78 (23.5%) had received one dose of vaccine; vaccination status for 175 (53%) of the cases was unknown. The trend with measles shows that the majority of measles cases are seen in children who are 1–4 years of age and 5–14 years of age. The neonatal and infant immunization would be made easier and safer with a vaccine that does not require needles or syringes and is immune-stimulating in the early stages of life.[17]

In May 2021, 130 specimens were born in the laboratory of a healthcare facility; out of that total, 130 specimens, 85 tested positive for measles IgM antibody. In October, 105 specimens were processed through the laboratory; of the 105 specimens processed, 13 were identified as negative cases of measles based upon the false positive results. Of the 29 specimens processed at the laboratory in February 2020, 26 tested positive for IgM antibodies, which indicated an active case of measles.

CONCLUSION

Children report significantly more measles because their immune systems are significantly compromised, there are weak vaccination programs in place, poor hygiene practices, a lack of proper nutrition and regular exposure to others who are ill, being critically ill, having panic-stricken children, having limited literacy, being in poverty, being unaware of the need for good hygiene, not having access to any vaccination centers; overcrowded housing; people having no idea how the diseases/virus spread (all are contributing factors).

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AUTHOR CONTRIBUTION

All authors made a significant contribution to the work reported, whether that is in the conceptualization, study design, execution, acquisition of data, data analysis and interpretation, or in all these areas; they took part in writing, revising or critically reviewing the manuscript; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for the contents of the article.

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