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Research Article

Clinical Characteristics and Outcomes of Children Hospitalized with Suspected Measles at Jimma University Medical Center, Ethiopia, Cross Sectional Study

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Abstract

Background: Measles, a highly contagious viral disease, remains a significant cause of morbidity and mortality among children in low-resource settings like Ethiopia. Despite the availability of vaccines, outbreaks persist, particularly in areas with low immunization coverage. This study aims to explore the clinical characteristics and outcomes of children hospitalized with suspected measles at Jimma University Medical Center (JUMC). Understanding these aspects will provide critical insights for improving case management and reducing measles-related complications and deaths. *Objectives:* The primary objective of this study was to assess the clinical characteristics, complications, and outcomes of children hospitalized with suspected measles at JUMC. *Methods:* This was a hospital-based retrospective study that involved the review of medical records of children admitted to JUMC with suspected measles over the past five years. Data on demographic characteristics, clinical features, laboratory findings, treatment interventions, and patient outcomes were extracted and analyzed. Descriptive statistics summarized the data, while multivariate analysis was used to identify factors associated with adverse outcomes. *Results:* A total of 250 children were studied (100% response rate). Slightly over half (51.6%) were from urban areas. Children were predominantly male (57.2%) and mainly aged 5-10 years (50.8%). Common symptoms were rash (100%), fever (99.2%), cough (97.2%), and conjunctivitis (85.2%), while 100% had maculopapular rash, 41.2% had Koplik's spots, and 10.4% had lymphadenopathy on physical examination. 82% of the cases were complicated with severe pneumonia while other complications identified were diarrhea (61.6%), Upper Respiratory Tract Infection (48.4%), dehydration (18.8%), Out of the total cases, 230(92%) had good outcomes, while 20 (8%) cases were died. Regarding factors associated with Poor Outcomes (Multivariable Analysis), being unvaccinated against measles (AOR=4.53, P=0.005), having malnutrition (AOR=4.14, P=0.029) and Laryngotracheobronchitis (Croup) (AOR=11.96, p=0.008) were significantly associated with increased risk of death.

Keywords

Measles, Clinical Characteristics, Outcomes, Children, Hospitalization, Jimma University Medical Center, Ethiopia

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1. Background

Measles remains one of the most contagious viral diseases, causing significant morbidity and mortality among children worldwide, particularly in low-resource settings. Despite the availability of an effective vaccine, measles continues to pose a public health challenge, especially in sub-Saharan Africa, where vaccination coverage is often inadequate [1]. Ethiopia, like many other countries in the region, experiences periodic measles outbreaks that disproportionately affect children under the age of five [2].

In Ethiopia, measles continues to be a major public health concern despite vaccination efforts. The country has faced several outbreaks in recent years due to incomplete vaccination coverage and other systemic [3]. Measles is characterized by a classic triad of symptoms: high fever, cough, coryza, and conjunctivitis, followed by a maculopapular rash. Complications can include diarrhea, otitis media, and pneumonia, with more severe outcomes including encephalitis and death [4].

The clinical presentation of measles in Africa is similar to other regions but is often compounded by high rates of malnutrition and co-infections, which can exacerbate the disease. Malnutrition can increase the severity of measles and lead to higher rates of complications and mortality [5]. High case-fatality rates in developing countries are due to a young age at infection, crowding, underlying immune deficiency disorders, vitamin A deficiency, and lack of access to medical care. Before the introduction of measles vaccines, one third of children in many developing countries were infected in the first and second years of life, and most children were infected before age 5 years [6].

According to WHO report 2023, there was an almost five-fold increase in confirmed measles cases between 2021 and 2022. Low population immunity, combined with concurrent epidemics, conflict, forced displacement, and other humanitarian crises that disrupt childhood vaccinations, are some factors that may explain the increases [7, 8]. Thus, the recent outbreaks of measles in Ethiopia have had a devastating impact on the population, with many children dying from the disease [7]. Similarly in JMC, we are encountering a lot of children with suspected measles cases in our daily activities and many of them were presenting with severe complications.

Measles is still responsible for more than 100,000 deaths every year, down from more than 2 million deaths annually before the introduction and widespread use of measles vaccine [9, 10]. It was a leading global cause of child morbidity and mortality before the introduction of measles vaccines in the 1960s, and was responsible for more than 2 million deaths annually before the increase in global measles vaccine coverage in the 1980s as a result of the EPI [10]. In 2016, an estimated 39.9 million measles cases and 777,000 deaths were recorded worldwide. Africa and East Asia account for 70% and 84% of measles and measles-related diseases reported worldwide [11, 12]. Most deaths from measles occur in children aged <5 years, making it one of the leading causes of childhood mortality globally. Nevertheless, a low-cost, safe vaccine is available, and persistent international efforts have been made to eradicate the illness [13].

The epidemiology of measles is largely determined by the respiratory mode of transmission, high contagiousness and lifelong immunity that follows infection or vaccination [10-12]. The estimation of the global burden of measles is challenging in the absence of reliable and comparable surveillance systems worldwide. In low-resource settings, measles continues to cause substantial morbidity and mortality among children. Studies have shown that regions with lower vaccination coverage experience frequent outbreaks and higher case fatality rates [2, 14-16]. For instance, a study conducted in Ethiopia reported that measles remains a leading cause of childhood morbidity and mortality, with outbreaks occurring in areas with low vaccine coverage and high population density [17].

Given the high burden of measles in Ethiopia, particularly among young children, it is imperative to investigate the clinical characteristics and outcomes of hospitalized cases. Such an investigation will provide valuable insights into the severity of the disease, common complications, and factors associated with poor outcomes. This knowledge is essential for guiding clinical practice, informing public health policies, and ultimately reducing the morbidity and mortality associated with measles. Jimma University Medical Center (JUMC), one of the largest referral hospitals in southwestern Ethiopia, regularly receives a large number of pediatric patients with suspected measles. However, there is limited data on the clinical characteristics and outcomes of these children, making it difficult to develop effective intervention strategies. Understanding the specific factors that contribute to severe outcomes in children with measles is crucial for improving patient management and reducing mortality rates.

2. Methods

A facility based cross sectional study was employed to assess the clinical characteristics and outcomes of children hospitalized with suspected measles at Jimma University Medical Center, Ethiopia.

2.1. Source Population

All children who visited JUMC, Ethiopia.

2.2. Study Population

All children aged 0-14 years who were admitted to JUMC with suspected measles during the study period.

2.3. Eligibility Criteria

2.3.1. Inclusion Criteria

All children with suspected measles who full fills WHO measles case definition.

2.3.2. Exclusion Criteria

1) Patient charts with incomplete documentation
2) Neonates below 1 month of age

2.4. Sample Size

Since I haven't get P-value from the previous similar studies, the minimal sample size (n) requirements were identified by using the formula for a single population proportion considering the following assumptions:

$$n = \frac{(z\alpha/2)^2 p\,(1-p))}{d^2} = \frac{(1.96)^2 0.5(1-0.5)}{(0.05)2^2} = 384$$

Considering the expected prevalence of 50% (p), 5% margin of error (d), 95% confidence level (Z). Since there might be non-response group, the final sample size was 422, by adding non response rate of 10%.

But due to incomplete documentations on the patient folders, missed folders from card room and wrong medical record numbers registered on the registration book, I got 250 cases for final data collection.

2.5. Sampling Technique

A consecutive sampling technique were used to select the study participant, where all eligible children admitted with suspected measles during the outbreak were included until the required sample size was achieved.

2.6. Study Variables

2.6.1. Dependent Variable

Patient outcomes (recovered, Death).

2.6.2. Independent Variables

Age, gender, vaccination status, Marital status, House hold size, Religion, Caregiver's occupation, Educational status, Distance from hospital, Family income, Child's nutritional status, clinical symptoms, treatment given, duration of hospitalization and comorbidities.

2.7. Operational Definitions

1) *Suspected Measles*: A case presenting with fever, generalized maculopapular rash, and at least one of the following: cough, coryza, or conjunctivitis, as per the WHO case definition.
2) *Outcome*: Refers to the end result or consequence of measles case which is categorized as recovery (discharged improved) or death.
3) *Death:* is absence of signs of life confirmed by physician while on treatment for suspected measles.
4) *Case fatality rate:* refers to the percentage of children who died from measles among those who were admitted with suspected measles.
5) *Recovered:* children discharged home improved.
6) *Complication:* Are sequelae following measles. Examples: pneumonia, acute gastroenteritis, dehydration, encephalitis, otitis media, febrile seizure, croup and visual impairment.
7) *Comorbidities*: another medical conditions like asthma, renal disease, cardiac disease or HIV/AIDS etc. which is presented in children with measles diagnosed at the time of presentation or before the current measles illness.

2.8. Data Analysis Procedures

Data were entered into Epidata and analyzed using SPSS version 26. Descriptive statistics (mean, median, frequency, and percentage) will be used to summarize demographic characteristics, clinical features, and outcomes. Binary logistic regression and multivariate logistic regression was used to evaluate the associated factors with poor outcomes. A p-value of <0.05 will be considered statistically significant with 95% CI AOR.

2.9. Data Quality Management

To ensure data quality, the questionnaire pretest was done on 5% of the sample size. Intensive training for the data collectors was given for two days before the actual data collection period and supervisors were regularly check the completeness of the questionnaires for consistency and accuracy. *The minimum sample size was calculated as 422 cases using the formula for prevalence studies*. To account for potential exclusions, 440 cases were identified from the cases registry log book. After screening, 190 cases were excluded due to missing cards (n=65), erroneous registration (n=41), or incomplete data (n=84), resulting in 250 cases analyzed (Figure 1).

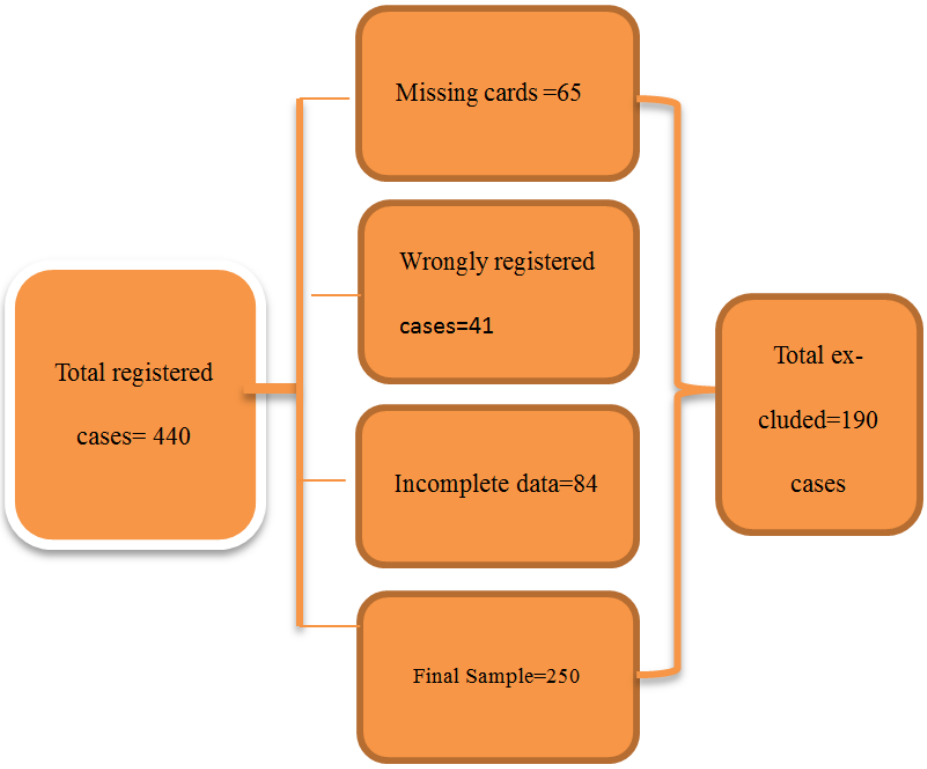

Figure 1. *Showing Flow Diagram of Case Selection.*

2.10. Ethical Considerations

Ethical approval for this study was obtained from the Institutional Review Board (IRB) of Jimma University.

Table 1. *Showing children and parents/care givers socio demographic characteristics (n=250).*

Study variables	Categories	Frequency	Percent%
Age of the children	Less than 6 Months	23	9.2
	6 - < 12months	33	13.2
	1 to <5 years	50	20
	5 to <10 years	127	50.8
	Greater than 10 years	17	6.8
Gender	Male	140	56
	Female	110	44
Religion of care giver	Muslim	218	87.2
	Orthodox	17	6.8
	Protestant	15	6.0
Education of care giver	Cannot read write	39	15.6
	Elementary	19	7.6
	High school	95	38.0
	College and above	97	38.8
Residency	Urban	129	51.6

Study variables	Categories	Frequency	Percent%
	Rural	121	48.4
	Single	3	1.2
Marital status of care giver	Married	246	98.4
	Divorced	1	0.4
	Not started	170	68
Education of the children	Kindergarten	30	12
	Elementary	50	20
	Mother	244	97.6
Child care givers	Father	2	0.8
	Other	4	1.6
	Farmers	42	16.8
	Government employee	24	9.6
Occupation of care givers	Daily labourer	5	2.0
	Merchant	25	10.0
	House wife	153	61.2
	Maid	1	0.4
The care giver heard about measles previously	Yes	50	20
	No	200	80

3. Results

3.1. Children and Parents/Care Givers Socio Demographic Characteristics

A total of 250 medical charts of the study participant was assessed and making a response rate of 100%. More than half 129(51.6%) of the study participants family resides in urban area with the majority 218(87.2%) being a Muslim religious follower. The median age of the study participants were 7 years with a minimum of 2 month and a maximum of 14 years. Regarding to gender more than half 140(57.2%) were males making male to female ratio of 1.27. (Table 1) The median family size was 5 with the minimum was 3 and maximum was 10 members, while the median distance of the patients residence from JUMC is 16km, with minimum and maximum distances are 1km and 39km respectively (Table 1).

3.2. Vaccination Status and Treatment Given at Other Facility Among Children with Suspected Measles

Table 2. *showing vaccination status and treatment given at other facility among children with suspected measles (N=250).*

Study variables	Categories	Frequency	Percent%
Was the child immunized?	Yes	104	41.6
	No	119	47.6
	Unknown	27	10.8
If immunized, how many doses? (N=104)	MV1 only	22	21.2
	Both MV1 and MV2	82	78.8

Study variables	Categories	Frequency	Percent%
Contact history with the same illness?	Yes	31	12.4
	No	56	22.4
	Unknown	163	65.2
Place of contact (N=31)	Home	28	90.3
	School	3	9.7
Visit to other health facility before visiting JUMC?	Yes	145	58
	No	105	42
Use of medication before visiting JUMC?	Yes	108	43.2
	No	142	56.8
Type of used medication	Ceftriaxone	68	62.9
	Ampicillin and gentamycin	40	37.1
Number of visits to JUMC hospital	First visit	228	91.2
	Revisit	22	8.8

Nearly half 119 (47.6%) of the study participants were not immunized against measles virus whereas more than one third 104(41.6%) of the children took the vaccine. Among the vaccinated children, 82(78.8%) took both MV1 and MV2. Almost two third 163(65.2%) of the children had unknown history of contact with similar cases while 31(12.4%) had direct contact to a person with similar illness, among which the contact was at home in 28(90.3%) of the study participants. More than half 145(58%) of the children were taken to a nearby health facility before arrival to Jimma university specialized hospital and 108(43.2%) of them were treated with antibiotics. The median day after the first symptom before arrival to health facility was 8 days with a minimum of one day and a maximum of 11 days (Table 2).

3.3. Clinical Characteristics Among Children Suspected with Measles

Almost all 250(100%) of the children with rash and 248 (99.2%) were presented with fever at the time of arrival to JUMC hospital making it the most reported symptoms among the study participants followed by cough 243(97.2%) and conjunctivitis 213(85.2%) respectively. The least presented symptom was epistaxis 2(0.8%) (Table 3).

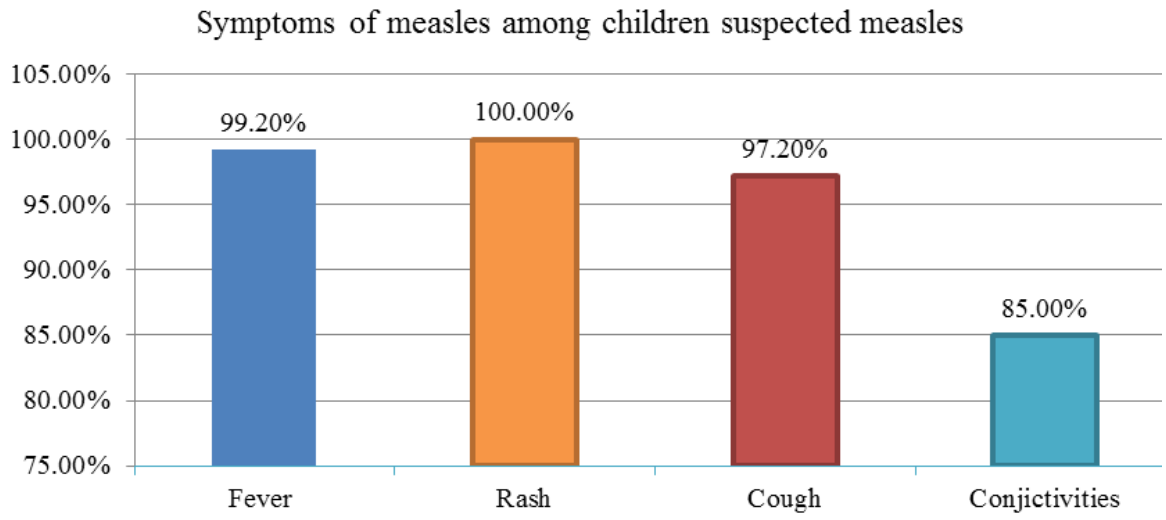

Figure 2. Bar graph showing symptoms of measles among children suspected measles (n=250).

Table 3. Showing clinical characteristics among children suspected with measles (n=250).

Study variables	Categories	Frequency	Percent%
Rash	Yes	250	100
	No	0	0
Fever	Yes	248	99.2
	No	2	0.8
Cough	Yes	243	97.2
	No	7	2.8
Coryza	Yes	187	74.8
	No	63	25.2
Diarrhoea	Yes	170	68
	No	80	32
Conjunctivitis	Yes	213	85.2
	No	37	14.8
Convulsion	Yes	7	2.8
	No	243	97.2
Stridor	Yes	15	6
	No	235	94
Epistaxis	Yes	2	0.8
	No	248	99.2
Vomiting	Yes	15	6
	No	235	94

3.4. Physical Finding Among Children with Suspected Measles (n=250)

Table 4. Showing physical finding among children with suspected measles (n=250).

Study variables	Categories	Frequency	Percent%
Maculopapular rash	Yes	250	100
	No	0	0
Koplik's spot	Yes	103	41.2
	No	147	58.8
Lymphadenopathy	Yes	26	10.4
	No	224	89.6
Pallor	Yes	9	3.6
	No	241	96.4
Stridor	Yes	24	9.6
	No	226	90.4

Regarding the clinical finding during physical examination, generalized maculopapular rash 250(100%) was the most common along with Koplik's spot 103(41.2%) and lymphadenopathy 26(10.4%) (Table 4).

3.5. Complications Identified Among Children with Suspected Measles

Table 5. showing complications identified among children with suspected measles (N=250).

Study variables		Categories	Frequency	Percent%
Had complication (N=250)		Yes	250	100
		No	0	0
Complications identified	Upper respiratory tract infection	Yes	121	48.4
		No	129	51.6
	Laryngotracheobronchitis	Yes	24	9.6
		No	228	91.2
	Pneumonia/severe Pneumonia	Yes	205	82
		No	45	18
	Acute otitis media	Yes	4	1.6
		No	246	98.4
	Ophthalmic	Yes	24	9.6
		No	226	90.4
	Encephalitis	Yes	7	2.8
		No	243	97.2
	Febrile seizure	Yes	0	0
		No	250	100
	AGE	Yes	154	61.6
		No	96	38.4
	Dehydration due to AGE	Yes	47	30.5
		No	203	69.5
Comorbid illness		Yes	68	27.2
		No	182	78.2
Comorbidities	Malnutrition (N=68)	Yes	42	61.7
		No	26	38.3
	Others	Cardiac	7	10.29
		Renal	3	4.4
		Malaria	6	8.82
		Others*	10	14.7
Type of Malnutrition		MAM	14	33.3
		SAM	20	47.6
		Stunted	8	19.1

*Others; 2 Asthma, 2 Down syndrome, 3 Rickets, 2 epilepsy and 1 Upper GI bleeding

More than three fourth, 205(82%) of the children were complicated with pneumonia or severe pneumonia followed by diarrhoea or AGE 154(61.6%) and upper respiratory tract infection 121(48.4%) respectively. On the other hand, 47(30.5%) of those with AGE developed dehydration (Table 5).

3.6. Treatment Given and Outcomes Among Children with Suspected Measles

Almost all 245(98%) of the study participant were treated with vitamin A and also nearly all 232(92.8%) took antibiotics, among this more than two third 192(76.8%) of them were treated with ceftriaxone. Nearly two third 155(62%) of them were given hydration fluid of which 154(61.6%) were those complicated with AGE. Among these 130(83.8%) of them took oral rehydration fluids (ORS) (Table 6). On the other hand, around three fourth 186(74.4%) of the children stays more than seven days during the course of treatment in the hospitals among which the majority 230(92.0%) discharged with improvement and only 20 (8%) were died (Figure 3).

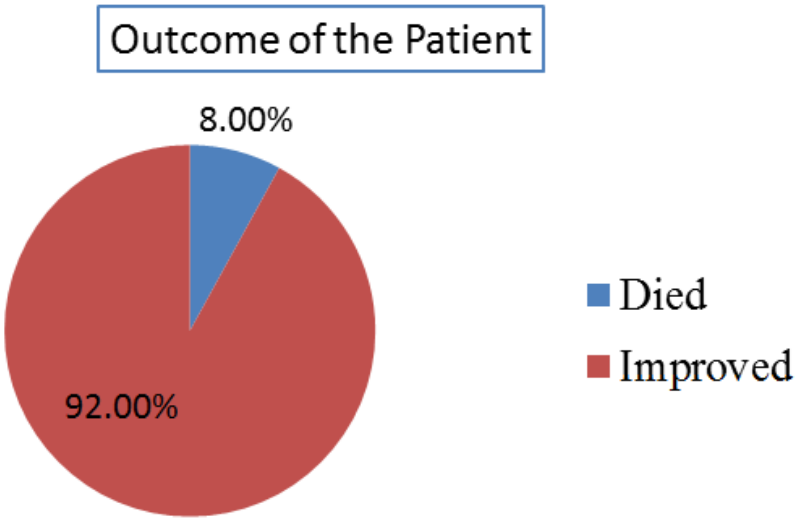

Figure 3. *Pie chart showing outcomes among children with suspected measles (n=250).*

Table 6. *showing treatment given and outcomes among children with suspected measles (N=250).*

Study variables	Categories	Frequency	Percent%
Vitamin A given	Yes	245	98
	No	5	2
Hydration fluid given	Yes	155	62
	No	95	38
Types of fluid given (N=155)	ORS	130	83.9
	IV	5	3.2
	Both	20	12.9
Treated with antibiotics	Yes	232	92.8
	No	18	7.2
Types of antibiotics (N=232)	Ceftriaxone	192	82.7
	Amoxicillin	12	5.2
	Ampicillin and gentamycin	19	8.2
	Others *	9	3.9

Study variables	Categories	Frequency	Percent%
Length of stay	<3 Days	15	6
	3-7 Days	49	19.6
	>7 Days	186	74.4
Outcomes	Improved	230	92
	Died	20	8

* Augmentin, Artesunate, cephalexin and etc

3.7. Factors Associated with Poor Outcome Among Children with Suspected Measles

All variables that are assumed to be a contributing factors for poor outcomes are entered to bivariate analysis and those variables with P-value < 0.25 were taken to multivariate analysis for determination of significant association. In multivariable analysis, having Laryngotracheobronchitis (Croup), vaccination status (being unvaccinated against MCV1 and MCV2) and having malnutrition were significantly associated to poor outcome. Those children who were not vaccinated against measles virus *(P=0.005, AOR=4.53, 95% CI: 1.07-19.12)* are four times more likely to die when compared to those children who were vaccinated against measles virus. Those who had malnutrition *(P=0.029, AOR=4.14, 95% CI: 1.16-14.83)* are nearly four times more likely to die than those who had no malnutrition as a comorbidity. Children who developed Laryngotracheobronchitis (Croup) *(P=0.027, AOR=11.96, 95% CI: 1.89-75.4)* are almost twelve times more likely to die than who had no Laryngotracheobronchitis.

Table 7. *Showing factors associated with poor outcome among children with suspected measles.*

Variables	Categories	Outcomes		COR (95%, CI)	AOR (95%, CI)	P-value
		Died (poor)	Improved (Good)			
Gender	Female	13(5.2%)	97(38.8%)	2.55(0.98-6.62)	3.01(0.713-12.7)	0.134
	Male	7(2.8%)	133(53.2%)	1		
Preexisting comorbidity	No	7(2.8%)	17(570%)	1		
	Yes	13(5.2%)	55(22%)	5.91(2.25-45.5)	1.54(0.3-7.91)	0.605
Malnutrition	No	8(3.2%)	200(80%)	1		
	Yes	12(4.8%)	30(12%)	10(3.78-26.5)	4.14(1.16-14.83)	0.029*
Diarrhea	No	11(4.4%)	88(35.2%)	1		
	Yes	9(3.6%)	142(56.8%)	0.51(0.2-1.27)	0.77(0.19-23.16)	0.715
Visit to health facility before arrival	No	12(4.8%)	93(37.2%)	1		
	Yes	8(3.2%)	137(54.8%)	0.45(0.18-1.15)	1.19(0.27-5.31)	0.813
Croup	No	13(5.2%)	213(85.2)	1		
	Yes	7(2.8%)	17(6.8%)	6.75(2.37-19.2)	11.96(1.89-75.4)	0.008*
Vaccination for measles	No	13(5.2%)	110(44%)	3.86(1.07-13.9)	4.53(1.07-19.12)	0.04*
	Unknown	4(1.6%)	22(8.8%)	5.94(1.24-28.5)	3.08(0.43-22.1)	0.263
	Yes	3(1.2%)	98(39.2%)	1		

NB; *Significant association with multivariable analysis 1= reference categories

4. Discussion

This study attempted to determine the clinical characteristics and outcomes of children hospitalized with suspected measles. Even though measles case is common in under five children in majority of studies, more than half (57.6%) of cases in this study were children of 5 and above years of age. Above half of the cases are male children. This is the same as the study done at East Gojjam Zone, Amhara Region where the majority of cases (70.5%) were in individuals over five years old, while 27.9% were in the under-five population. The disease was slightly more prevalent in males (51%) compared to females (49.3%) [18]. Another study at Berhet district in North Showa, Ethiopia, showed the outbreak affected a broader age range with a high attack rate mainly in the age group of 5-14-years comprised 57.4% of cases [19]. Studies showed the reason why measles cases are increasing in above 5 years old children were due to lack of vaccination and **o**utbreaks in under vaccinated communities [19, 20].

Among the children with suspected measles the most commonly presented clinical presentations were rash (100%), fever (99.2%), cough (97.2%) and conjunctivitis (85.2%) respectively. This finding was in line with a study conducted in Mogadishu Somalia, and Guradamole district, Ethiopia and Study done in Indonesia by Dominiscus etal, where almost all the study participants had rash, fever, cough and conjunctivitis [15-17]. This can be best explained as the clinical presentation may be the typical sign of measles cases across the globes.

Regarding to clinical finding during physical examination, generalized maculopapular rash (98.4%) with kolpik's spot (41.2%) was the most commonly seen symptoms in this study which is lower than a study conducted by Mohamud at other centre in Somalia, in which 67.7% had a rash and 30.1% had Koplik's spots [4]. This might be due to the small sample size of the study subject they used. And also, the current study shows the majority of the children had pneumonia as a complication of measles which is supported by a study done in Tocha district of the Dawuro zone, Southwest Ethiopia and Mogadisho, Somalia [2, 4]. A five year review of hospitalized children with measles in Nigeria also showed almost similar results where observed complications included bronchopneumonia in 168 (82.4%), acute laryngotracheobronchitis in 24 (11.8%), and otitis media in 6 (2.9%) patients [21]. Laryngotracheobronchitis (Croup) accounts 9.6% of the cases in this study which is slightly lower than the study done by Commey & Richardson in Ghana from 1973-1982, which was 494(11.4%) [22]. In addition to this diarrhoea was the second most seen complication of measles in this study (61.6%) which is higher than the study done in Jordan (28%) and in Nigeria 101 (49.5%) [21, 23].

In the current study less than one fourth 20(8%) of the children are died. This finding was much higher than a study conducted in Mogadishu Somalia, in which only two (1.8%) children were died; this discrepancy may be due to the study sample size used in this study [15]. But it is in line with the study done at Guradamole district, in which a case fatality rate (CFR) was 7%. A systemic review by Sbarra and his colleagues showed CFR of 8.7% in sub-Saharan Africa in hospital settings which is similar with this study [24]. This high CFR was attributed to low vaccination coverage and high prevalence of malnutrition [24].

Being unvaccinated for measles, having laryngotracheobronchitis (Croup) and having malnutrition as a pre-existing comorbidity were significantly associated to poor outcome in this study.

Having pre-existing malnutrition are nearly four times more likely to result in poor outcomes among children with the condition than without it. This finding was supported by different studies [2, 3, 25]. This is because malnutrition weakened the immune system and increase the chance to develop other complications like pneumonia and diarrhoea to the children, thereby make them more likely to die than those who had no malnutrition.

Those children with laryngotracheobronchitis (Croup) are almost twelve times more likely to die when compared to those without Laryngotracheobronchitis (Croup). This finding is also supported by different studies where laryngotracheobronchitis complicating measles was associated with high mortality. A study of 124 hospitalized children with measles (Houston, Texas 1990) found that 27 developed significant LTB. Six required endotracheal intubation, and two (7%) were died [26]. Among 784 measles cases, in Kabul, Afghanistan (1980-1982), 22% developed LTB. The overall mortality rate was 10.8%, with LTB and bronchopneumonia being the most common causes of death [27]. Bacterial and viral superinfection could contributed to the severity of measles-related LTB in our patients as described in other studies.

Those children who were not vaccinated against measles virus are four times more likely to die when compared to those children who were vaccinated against measles virus. This result is nearly 2 times higher than the study conducted in Philiphines from 2016-2019, where children who were unvaccinated against measles were 1.86 times more likely to die than those who were vaccinated for measles [28]. A meta-analysis and systemic review in Ethiopia by Tariku, etal. Showed that being unvaccinated for measles was associated with high measles attack rate and case fatality rate which supports this study [29].

Limitation of the Study

The limitation of this study was:

1) Missing Records: Some patient folders were missing from the records room, limiting access to complete case information.
2) Incorrect Registration: There were instances of incorrect patient record numbers in the registration book, which affected the ability to accurately track and get required number of cases.

3) Incomplete Investigations: investigations were not completed for the majority of cases so that laboratory result were not included in the study.
4) Retrospective Design: The retrospective nature of the study posed challenges in retrieving certain important data, resulting in incomplete information in some cases.

5. Conclusion and Recommendations

5.1. Conclusion

This study conducted at Jimma University Medical Center (JUMC) highlights the significant clinical burden of measles among hospitalized children in Ethiopia, where rash, fever, cough, and conjunctivitis were the predominant symptoms, and pneumonia and diarrhoea were common complications. Despite a recovery rate of *92%*, the *8%* fatality rate was notably associated with incomplete vaccination, malnutrition, and croup. Alarmingly, nearly half of the children were unvaccinated, reflecting substantial gaps in immunization coverage. These findings emphasize the urgent need to strengthen vaccination efforts, improve nutritional status, and enhance healthcare access to mitigate measles-related morbidity and mortality in low-resource settings.

5.2. Recommendations

To reduce measles-related illness and death, this study recommends a multifaceted approach that includes strengthening vaccination programs-especially in underserved areas through improved coverage and community engagement; integrating nutritional support by screening for and treating malnutrition among measles patients; and promoting further research and policy advocacy to address systemic barriers and secure sustainable funding for immunization and healthcare services.

To address the high measles prevalence among children over 5 years old, it is crucial to expand vaccination efforts beyond the under-5 age group through school-based and catch-up campaigns.

Abbreviations

AGE	Acute Gastroenteritis
AR	Attack Rate
CDC	Center of Disease Control and Prevention
CFR	Case Fatality Rate
CKD	Chronic Kidney Disease
EPI	Expanded Programme on Immunization
HIV/AIDS	Human Immunodeficiency Virus/ Acquired Immunodeficiency Syndrome
JUMC	Jimma University Medical Center
LTB	Laryngotracheobronchitis
MCH	Maternal and Child Health
MCV	Measles Containing Vaccine
OPD	Out Patient Department
PICU	Pediatric Intensive Care Unit
PI	Principal Investigator
SPSS	Statistical Package for the Social Sciences
WHO	World Health Organization

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Conflicts of Interest

The authors declare no conflicts of interest.

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