Journal of Medical and Health Studies
ISSN: 2710-1452
DOI: 10.32996/jmhs
Journal Homepage: www.al-kindipublisher.com/index.php/jmhs

JMHS
AL-KINDI CENTER FOR RESEARCH AND DEVELOPMENT

| RESEARCH ARTICLE

Measles-Related Pneumonia Association on Severely Wasting Children

Jessica Sofian[1], Ghaisania Athira[2], Johnwan Usman[3], Rachmanto HSA[4] and Nathania Thedra[5] ✉

[15]*School of Medicine and Health Sciences, Atma Jaya Catholic University of Indonesia, Indonesia*
[2]*Faculty of Medicine, Trisakti University, Indonesia*
[34]*Department of Child Health, Hermina Podomoro General Hospital, Indonesia*

Corresponding Author: Nathania Thedra, **E-mail**: nathania_thedra@yahoo.com

| ABSTRACT

In developing countries, measles is a highly contagious infectious disease that is transmitted through droplets or aerosols and can be fatal in complicated cases. Risk factors attributable to measles severity include age, nutritional and immunization status. Children who are severely wasting are more likely to develop measles-related complications; one of the most frequent complications is pneumonia, which is responsible for most measles-related morbidity and mortality. Through this study, we aim to assess the association between severely wasting nutritional status and the complications of measles-related pneumonia. A retrospective cohort analytic study of 45 children aged 1 to ≤ 60 months old was conducted. The study was conducted based on measles prevalence data in Hermina Podomoro General Hospital Paediatric Ward in the period April 2022 – March 2023. Nutritional status was assessed through WHO W/H Z-Score for children ≤ 60 months old. Pneumonia complication was diagnosed by clinical findings and chest radiograph. Data analysis was performed using the chi-square test with IBM SPSS Statistics Version 27. There were 39 children included in this study. Children aged >48 – ≤ 60 months had the highest proportion of confirmed measles cases (30.8%). Measles clinical symptoms of koplik's spot, macopapular rash, and fever were found in all enrolled patients. We found 64.1% of patients had severely wasting nutritional status, with 53.8% cases undergoing pneumonia complications, and 46.1% of enrolled patients had both severely wasting nutritional status and pneumonia complications. Analytic bivariate analysis found a statistically significant association between severely wasting nutritional status and pneumonia complication ($p=0.02$, $p<0.05$). There is an association between severely wasting nutritional status and the complication of pneumonia in children with measles.

| KEYWORDS

Measles, Severely Wasting, Measles-Related Pneumonia, Measles Complications

| ARTICLE INFORMATION

ACCEPTED: 29 August 2023 **PUBLISHED:** 09 September 2023 **DOI:** 10.32996/jmhs.2023.4.5.4

1. Introduction

Measles is a highly contagious infectious disease primarily affecting children and caused by the measles virus. It spreads through respiratory droplets or aerosolized particles. Measles is often diagnosed clinically with symptoms that include high fever, appearance of erythematous maculopapular rash, koplik's spots, cough, coryza and conjunctivitis. (Perry et al, 2004)There are some risk factors that are attributable to the severity of measles, including age, nutritional status and immunization status. Several studies have stated that children with poor nutritional status have a higher incidence of secondary infection as a complication of measles. (Ylade, 2018) It is estimated that 6.7% of children under 5 years old are wasting and that 22% are stunted due to childhood malnutrition globally. (United Nations Children's Fund,2021) According to earlier research, children who are both moderately and severely malnourished are more likely to die from pneumonia. (Chisti et al., 2009)

Pneumonia is one of the most severe complications, where 1 in 20 patients die as a result of it. Approximately four out of five measles-related deaths are directly attributable to pneumonia in some way, with severe bronchopneumonia accounting for the majority of cases, as is widely documented (Rupp et al. 1993). Pneumonia can result from the measles virus alone, or it may be a consequence of secondary viral infections such as adenovirus or HSV, or even secondary bacterial infections. (Quiambao et al 1998) Hospitalized children with malnutrition, with up to two-thirds of them diagnosed with pneumonia, were studied to investigate the association between nutritional status and the incidence of pneumonia, which is the most common cause of death from measles in young children.

2. Methods

A retrospective cohort analytic study of 45 children aged 1 to ≤ 60 months with measles was conducted. The study was conducted based on medical record data in the Hermina Podomoro General Hospital Paediatric Ward in the period April 2022 – March 2023. Assessment of nutritional status was determined based on WHO Weight/Height (W/H) Z-Score in children under ≤ 60 months old, where severely wasting was defined as follows: WHO W/H Z-Score <-3. Measles diagnosis in children was assessed through CDC clinical characteristics such as high fever, cough, runny nose (coryza), red, watery eyes (conjunctivitis), koplik's spot and maculopapular rash.

The development of measles is proven by the incidence of complications, namely pneumonia, which is diagnosed through clinical symptoms and examination of chest radiographs. Inclusion criteria were: (a) children aged 1 to ≤ 60 months with measles from April 2022 – March 2023, (b) children aged 1 to ≤60 months with measles without any previous health problems. Data analysis was performed using the chi-square test with IBM SPSS Statistics Version 27.

3. Results

There were 39 children in the inclusion criteria. The mean age of children who had measles was 36 months (SD=18.2). Children aged >48 – ≤ 60 months had the highest percentage of confirmed measles cases (30.8%), then children >36 – ≤ 48 months at 20.5%, while aged 1 – ≤ 36 months old comprised 15.4 – 17.9% of confirmed cases. There was little difference in the sex of our enrolled patients, where 51.3% were female, and 48.7% were male; as for nutritional status, 64.1% of patients had severely wasting nutritional status (WHO W/H Z-Score <-3), patients with normal nutritional status (20.5%) and overweight nutritional status (5.5%). All enrolled patients were admitted to our pediatric ward; clinical manifestations of measles in the form of koplik's spots, maculopapular rash, and fever were found in all patients (100%), along with cough (87.2%), coryza (69.2%), conjunctivitis (8%), and sore throat (8%). 53.8% of measles cases underwent pneumonia complications, and 46.1% of enrolled patients had both severely wasting nutritional status and pneumonia complications. Only 51.2% of enrolled patients received measles vaccination. The results of bivariate analysis found a statistically significant association between severely wasting nutritional status and pneumonia complication ($p=0.02$, $p<0.05$).

Table 1. Associated-Risk Factors of Enrolled Patients

Associated-Risk Factors of Enrolled Patients		
Characteristics	Frequency (N)	Percentage (%)
Age (Mean ± SD) (36 months ± 18.2)		
1 - ≤ 12 months	6	15.4%
>12 - ≤ 24 months	7	17.9%
>24 - ≤ 36 months	6	15.4%
>36 - ≤ 48 months	8	20.5%
>48 - ≤ 60 months	12	30.8%
Sex		
Male	19	48.7%
Female	20	51.3%
Nutritional Status (WHO W/H Z-Score)		
Severely Wasting	25	64.1%
Wasting	4	10.2%

Normal	8	20.5%
Overweight	2	5.5%
Obese	0	0.0%
Vaccination Status		
Vaccinated	20	51.2%
Unvaccinated	19	48.7%

Table 2. The Distribution of Measles-Related Pneumonia Complications with Nutritional Status

Nutritional Status (WHO W/H Z-Score)	Pneumonia Complication			
	Present		Absent	
	Frequency (N)	Percentage (%)	Frequency (N)	Percentage (%)
Severely wasting	18	46.1%	7	17.9%
Wasting	3	7.6%	1	2.5%
Normal	0	0%	8	20.5%
Overweight	0	0%	2	5.1%
Obese	0	0%	0	0%

Table 3. Measles Clinical Criteria of Enrolled Patients

Measles Clinical Criteria		
Clinical Symptoms	Frequency (N)	Percentage (%)
Conjungtivits	8	20.5%
Fever	39	100%
Koplik's Spot	39	100%
Macopapular Rash	39	100%
Cough	34	87.2%
Coryza	27	69.2%
Sore Throat	8	20.5%

Table 4. The Association between Severely Wasting Nutritional Status and Pneumonia Complication

Nutritional Status (WHO W/H Z-Score)	Pneumonia Complication		P-Value
	Present (N)	Absent (N)	
Severely wasting	18	7	0.02

4. Discussion and Conclusion

Measles is described as a feverish illness with a distinct red, flat, and bumpy rash. It is highly contagious, with symptoms starting with a high fever approximately 10 to 14 days after exposure to the virus and lasting for 4 to 7 days. At the onset, individuals usually experience at least one of the three "C's" – cough, coryza (inflammation of the mucous membranes in the nose), and conjunctivitis (inflammation of the eyes). The pathognomonic sign in the early stage (1-2 days before the appearance of the rash) was the small white spot in the buccal mucosa called Koplik's spot (Moss 2017). In our study, all cases (100%) presented with fever, erythematous maculopapular rash and Koplik's spot. The peak of the disease occurs when the erythematous rash appears 3 to 4 days after the onset of the fever; initially, the rash appears on the face and behind the ears, extending along the hairline, before spreading to the body and limbs. The rash persists for 3 to 7 days and then gradually diminishes in the same pattern it emerged. In malnourished children, the rash can take on a darker color and peel off during the recovery period. (Alawad et al. 2023) Measles affects multiple systems and can cause a lot of complications, most common in young infants and those who are immunocompromised or malnourished. One of the most frequent sites of the complication is the respiratory system, with

pneumonia responsible for most measles-related morbidity and mortality. (Li et al 2015)

Pneumonia can be due to the measles virus itself but is most often caused by a secondary bacterial or viral such as adenovirus, parainfluenza or HSV pathogens. The characterization of bacterial and viral pathogens linked to pneumonia in children with measles remains incomplete. (Wang et al. 2022) Malnutrition may play a role in the development of pneumonia by further decreasing the immune response brought by having a measles infection, and hence, prolonged excretion of the measles virus may be attributable to the development of measles-associated complications. Although there are many studies that have reported the association between malnutrition and measles-associated complications, little is known about the true mechanisms behind the potential association between measles and malnutrition. (Tran et al 2023) Various studies have examined the immunoglobulin levels of malnourished children and found them to be comparable to well-nourished children, except for decreased levels of IgA in malnourished individuals. Additionally, a previous study revealed higher percentages of IL-4-producing T-cells in malnourished children compared to their well-nourished counterparts. Furthermore, elevated levels of serum IL-4 have been detected in malnourished children, which could potentially contribute to the increased serum immunoglobulin levels observed in these individuals. Secretory IgA plays a crucial role in the mucosal immune response, protecting the upper respiratory tracts from infections by pathogenic organisms. The reduced IgA levels in malnourished children may lead to compromised immune responses against respiratory infections, making them more susceptible to measles-associated pneumonia. (Rodríguez 2011) In this study, 46.1% of cases had a severely wasting nutritional status and presented with measles-related pneumonia; this finding supports results found in another study reported by *Asghar et al.* that 40% of the measles patients present with a severely wasting nutritional status. (Asghar 2022) In a separate research by Caulfield et al., it was discovered that 44.8% of measles-related fatalities in young children were linked to malnutrition. They further projected that eliminating child undernutrition could potentially prevent around 250,000 cases of measles-related deaths. (Laura 2004)

Vitamin A deficiency is a significant public health concern in low to middle income countries, including Indonesia, and has been linked to severe cases of measles. The World Health Organization (WHO) suggests a vitamin A treatment protocol for measles, involving two doses of 50,000 IU for infants under 6 months, 100,000 IU for those between 6 months and 1 year, and 200,000 IU for individuals over 1 year, administered over two consecutive days. Children showing clinical signs of vitamin A deficiency are advised to receive a third dose 2 to 4 weeks later. (WHO 2017) As of now, there is no targeted antiviral treatment available for measles. The current approach to managing the disease involves providing supportive therapy to address dehydration and nutritional deficiencies if present, as well as promptly recognizing and treating any secondary bacterial infections. (Graber 2020)The high level of contagiousness of measles, coupled with the lack of specific treatment for the disease, emphasizes the importance of prevention as a crucial approach to combat it. (Guerra et al 2017) Measles vaccination is the most efficient method to halt the transmission of measles. It is estimated that since 2000, measles vaccines have averted more than 21 million deaths worldwide caused by measles. (Yang et al., 2019) Measles vaccination has been recommended by the WHO since 1974 and has been introduced to the routine childhood immunization schedule of many countries around the world to diminish children's morbidity and mortality from measles. (Keja et al. 1988)

It can be concluded that there is an association between severely wasting nutritional status and the complication of pneumonia in children with measles.

Funding: This research received no external funding.
Conflicts of Interest: The authors declare no conflict of interest.
Publisher's Note: All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers.

References

[1] Alawad MJ, Nauman A, Ahmed FS, Kaul R, Neffati N. (2023) Measles pneumonitis, an important cause to recognize in the era of COVID-19: a case report. Ann Med Surg (Lond). 2023 Apr 3;85(4):1273-1275. doi: 10.1097/MS9.0000000000000524. PMID: 37113936; PMCID: PMC10129177.
[2] Asghar RM, Sharif M, Khan IY, Syed AH, Ashraf RR, Hussain M. (2022). Complications of Measles in Malnourished Children, a Descriptive Cross-Sectional Study at a Tertiary Care Hospital Rawalpindi. *JRMC*; 2022; 26(1): 107-111.
[3] Chisti MJ, Tebruegge M, La Vincente S. (2009) Pneumonia in severely malnourished children in developing countries - mortality risk, aetiology and validity of WHO clinical signs: a systematic review. *Trop Med Int Health* 2009;14:1173–89. 10.1111/j.1365-3156.2009.02364
[4] Graber EMA, Andrade FJ, Bost W, Gibbs MA. (2020) An Update and Review of Measles for Emergency Physicians. *The Journal of Emergency Medicine*. 2020;58(4):610-615. https://doi.org/10.1016/j.jemermed.2020.02.007.
[5] Guerra FM, Bolotin S, Lim G, Heffernan J, Deeks SL Li Y, Crowcroft NS. (2017) The basic reproduction number (R(0)) of measles: a systematic review. *Lancet Infect Dis*. (2017) 17:e420–e8. doi: 10.1016/s1473-3099(17)30307-9
[6] Keja K, Chan C, Hayden G, Henderson RH. (1988) Expanded programme on immunization. World Health Stat Q. (1988) 41:59–63.

[7] Li J, Zhao Y, Liu Z, Zhang T, Liu C, Liu X. (2015) Clinical report of serious complications associated with measles pneumonia in children hospitalized at Shengjing Hospital, China. *J Infect Dev Ctries*. 2015;9:1139–1146. doi: 10.3855/jidc.6534
[8] Laura E (2004) Caulfield and others, Undernutrition as an underlying cause of child deaths associated with diarrhea, pneumonia, malaria, and measles, *The American Journal of Clinical Nutrition*. July 2004;80(1): 193–198, https://doi.org/10.1093/ajcn/80.1.193
[9] Moss WJ. (2017) Measles. Lancet. 2017 Dec 2;390(10111):2490-2502. doi: 10.1016/S0140-6736(17)31463-0. Epub 2017 Jun 30. PMID: 28673424.
[10] Perry RT, Halsey NA. (2004) The Clinical Significance of Measles: A Review. *The Journal of Infectious Diseases*. 2004;189(1):S4-16. https://doi.org/10.1086/377712
[11] Quiambao BP, Gatchalian SR, Halonen P, et al. (1988) Coinfection is common measles-associated pneumonia. *Pediatr Infect Dis J*. 1998; 17: 89–93.
[12] Rodríguez L, Cervantes E, Ortiz R. (2011) Malnutrition and Gastrointestinal and Respiratory Infections in Children: A Public Health Problem. *Int. J. Environ. Res. Public Health*. 2011;8:1174-1205; doi:10.3390/ijerph8041174
[13] Rupp, M. E., Schwartz, M. L., & Bechard, D. E. (1993). *Measles Pneumonia. Chest, 103(5), 1625–1626.*doi:10.1378/chest.103.5.1625
[14] Tran ICT, Gregory C, O'Connor P, Imohe A, Do LAH, Suchdev PS. (2023) A scoping review on the associations and potential pathways between malnutrition and measles. *medRxiv*. 2023. doi: https://doi.org/10.1101/2023.01.21.2328487
[15] United Nations Children's Fund (UNICEF) WHO, (2021) International Bank for Reconstruction and Development/The World Bank. *Levels and trends in child malnutrition: key findings of the 2021 edition of the joint child malnutrition estimates*. Geneva: World Health Organization, 2021.
[16] Wang, R., Jing, W., Liu, M., & Liu, J. (2022) Trends of the Global, Regional, and National Incidence of Measles, Vaccine Coverage, and Risk Factors in 204 Countries From 1990 to 2019. *Frontiers in Medicine*. 2022;8. https://doi.org/10.3389/FMED.2021.798031/BIBTEX
[17] WHO. Measles vaccines. (2017). WHO position paper—April 2017. *Wkly Epidemiol Rec* 2017; 92: 205–27
[18] Yang L, Grenfell BT, Mina MJ. (2019) Measles vaccine immune escape: should we be concerned? Eur J Epidemiol. (2019) 34:893–6. doi: 10.1007/s10654-019-00574-7
[19] Ylade, M. C. (2018) Risk factors of developing Pneumonia Among Confirmed Measles Cases. *Acta Medica Philippina*. 2018;42(4): 319-25.