JOURNAL LA MEDIHEALTICO

VOL. 06, ISSUE 01 (149-158), 2025
DOI: 10.37899/journallamedihealtico.v6i1.1836

Analysis of Risk Factors Associated with Measles Incidence in Toddlers in South Halmahera Regency

Syarif Abdullah[1], Novita Ana Anggraini[1], Yuly Peristiowati[1]

[1]*Universitas Strada Indonesia*

**Corresponding Author: Syarif Abdullah*
E-mail: ghalyhina2023@gmail.com

Article Info

Article history:
Received 10 December 2024
Received in revised form 12 January 2025
Accepted 30 January 2025

Keywords:
Immunization Status
Nutritional Status
Exclusive Breastfeeding
Environment
South Halmahera Measles Disease

Abstract

Measles is an internal disease (VPD) caused by Morbilivirus. This disease is characterized by the appearance of fever, reddish spots, cough, runny nose, red eyes and rashes all over the body which generally occurs in children. Measles, also known as Morbili or Measles, is a disease caused by the measles virus of the Paramyxovirus group. Transmission can occur through air that has been contaminated by droplets (spit) of an infected person. This case tends to attack early childhood and elementary school age children. Once a person has had measles, he or she will have lifelong immunity to the disease The aim of this research is to determine the factors related to the incidence of measles in toddlers in South Halmahera Regency. The research design used is quantitative research using a "case control" approach. The sampling technique used was purposive sampling with a sample of 106 consisting of 53 case groups and 53 control respondents. Data analysis techniques use Chi Square, Multivariate and Logistic Regression tests. The results of the research show that of the 106 respondents studied, the factors that most influence the incidence of measles in toddlers 0 - 59 months based on the beta value and p value, it is found that the environmental variable has a value < α, namely .021 and the beta value is -1.830, so the variable with the most dominant is the environment. Conclusion. The factors that most influence the occurrence of measles are environmental factors, so it is necessary to conduct socialization or education on the importance of environmental cleanliness to prevent the emergence of measles in children under five.

Introduction

Measles is one of the diseases categorized under Internal Diseases (PD31) caused by the Morbillivirus (Ponidjan et al., 2024; Rifani et al., 2024). It is characterized by fever, reddish spots, cough, runny nose, red eyes, and a rash spreading across the body, commonly affecting children. Measles is highly contagious and a leading cause of child mortality, particularly in countries across Africa and Asia. Over 95% of measles-related deaths occur in developing countries with low per capita income and weak healthcare infrastructure. In 2013, 145,700 deaths were attributed to measles, averaging around 400 deaths per day, mostly involving toddlers (Kemenkes, 2018).

Measles, also known as Morbilli or Rubeola, is a disease caused by a Paramyxovirus measles virus (Kurniasih et al., 2024; Yalpira, 2024). Transmission occurs through airborne droplets from infected individuals. The disease tends to affect preschool and elementary-aged children. Once infected, individuals acquire lifelong immunity against measles (Yonanda, 2022; Ringo et al., 2022). According to a joint report by WHO and the US CDC on November 17, 2023, progress in measles elimination from 2000 to 2022 showed an increase in global first-dose

measles vaccination coverage from 72% to 86% during 2000–2019, but this declined to 81% in 2021 during the COVID-19 pandemic—the lowest since 2008. In Indonesia, the first-dose measles vaccination coverage for infants aged 12–23 months in 2021 was only 72% (WHO, 2024).

Indonesia is one of 47 countries contributing significantly to global measles cases. In 2019, there were 14,640 reported cases of measles in Indonesia, higher than in 2017 (12,681) and 2018 (8,185). Globally, the morbidity rate for measles is 5 to 10 cases per 10,000 people, with a mortality rate of 1 to 3 per 1,000 individuals. In Indonesia, measles remains the fifth most common disease affecting infants and toddlers. Between 2016 and 2020, there were 89,127 suspected measles cases and 22 deaths reported. Laboratory results confirmed 19,392 measles cases and 14,192 rubella cases, with a positivity rate of 75%. Despite high immunization coverage, outbreaks are still possible, especially in areas with low vaccination rates (Ministry of Health of the Republic of Indonesia, 2020).

In 2022, Indonesia reported 4,845 confirmed measles cases, with 93% (4,502 cases) occurring in individuals aged 1–14 years. Some cases involved older individuals, with 41 cases reported among people over 40 years of age. Of the confirmed cases, 67% had not received any measles-containing vaccine (MCV), 6% had received one dose, 7% had received a second dose, and vaccination history was unknown for 21% (991 cases) (WHO, 2023).

Measles remains a public health issue in North Maluku, particularly due to ongoing cases and outbreaks in areas with low vaccination coverage. In 2022, measles vaccination coverage in North Maluku Province was 63.9%, with 817 reported cases (North Maluku Provincial Health Office, 2022). Vaccination coverage by district in North Maluku in 2022 was as follows: Pulau Morotai (75%), Pulau Tidore Kepulauan (61.8%), Pulau Taliabu (61.4%), East Halmahera (60.3%), South Halmahera (59.6%), North Halmahera (58.1%), Central Halmahera (57.7%), West Halmahera (49.2%), Sula Islands (47%), and Ternate City (25%).

In South Halmahera, data from the local health office in 2022 showed an increase in measles cases from 61 cases in 2022 to 110 cases in 2023. These cases were distributed across 15 health centers: Labuha, Gandasuli, Maffa, Saketa, Babang, Bisui, Laiwui, Madopolo, Dolik Lelei, Wayaloar, Sum, Indong, Palamea, and Indari (Health Profile of South Halmahera, 2022). Current outbreaks are primarily attributed to suboptimal community immunity, as evidenced by growing immunity gaps. According to the WHO/UNICEF Joint Reporting Form (JRF), Indonesia's vaccination coverage in 2020 was 87% for the first dose of a measles-containing vaccine (MCV1) and only 65% for the second dose (MCV2). In 2021, the national MCV1 coverage remained at 87%, while MCV2 coverage was 59%, with regional disparities in administrative vaccination coverage. These figures indicate a significant number of children remain vulnerable to measles (WHO, 2024).

Measles is a human disease caused by a virus in the Paramyxovirus family. The virus infects the respiratory tract and then spreads throughout the body, potentially causing large epidemics with significant morbidity and mortality, particularly among vulnerable groups (Leung, 2021; Javanian et al., 2021). These include malnourished children, pregnant women, and immunocompromised individuals, such as those with HIV, cancer, or those undergoing immunosuppressive treatments. Complications from measles may include severe diarrhea, blindness, encephalitis, pneumonia, and death. In 2022, the incidence of measles and rubella increased significantly compared to 2021 due to disruptions in surveillance and immunization services caused by the COVID-19 pandemic, which exacerbated immunity gaps (Ministry of Health of the Republic of Indonesia, 2022).

Transmission of measles primarily occurs from person to person through airborne respiratory droplets, which can spread quickly when an infected person coughs or sneezes. Transmission can also occur through direct contact with infected secretions. Although transmission from

asymptomatic immune individuals has not been proven, the virus can remain airborne or on contaminated surfaces for up to two hours (Sumampouw & Nelwan, 2024). A patient can transmit the disease from four days before the rash appears until four days afterward. While there is no specific antiviral treatment for measles, most individuals recover within 2–3 weeks (WHO, 2023).

To prevent and control measles, effective and safe vaccines are available. The first dose (MCV1) is administered at nine months of age, while the second dose (MCV2) is given at 15 months. Achieving 95% coverage for both MCV1 and MCV2 is necessary to halt measles transmission.

In areas with low vaccination coverage, measles epidemics generally occur every two to three years, lasting between two and three months. However, the duration of outbreaks can vary depending on population size, density, and immunity levels (Ministry of Health, RI, 2022). Measles is a highly contagious disease characterized by prodromal symptoms, including fever, cough, runny nose, and conjunctivitis, followed by a maculopapular rash that spreads across the body.

According to (Fatimah Ramadhani et al., 2016), measles occurs due to interactions between the host, agent, and environment. Any changes in these components can disrupt the balance, leading to outbreaks. Research by (Fatimah Ramadhani et al., 2016; Prabowati et al., 2016) identified several risk factors, including age, nutritional status, immunization status, vitamin A supplementation, exclusive breastfeeding, housing density, ventilation, history of contact, and maternal knowledge. (Widayat et al., 2014) noted that measles can lead to death, primarily due to complications like bronchopneumonia, which arise from weakened immune defenses.

Measles vaccination offers protection by providing immunity against the disease (Fatimah Ramadhani et al., 2016). However, (Rahmayanti, 2015) found no significant association between immunization status and measles incidence (OR=0.112). Conversely, (Fatimah Ramadhani et al., 2016) reported that unvaccinated children were 16.92 times more likely to contract measles than vaccinated ones.

Widayat et al. (2014) highlighted that measles is highly contagious, with 90% of cases involving contact with other infected individuals. The virus spreads via large respiratory droplets or small airborne droplets. Exposure typically results in infection 14–15 days later (Setiawan, 2008).

The introduction of the measles virus among refugees or vulnerable populations can lead to severe outbreaks with high mortality rates. Research by (Prabowati et al., 2016) indicated that children with a history of contact with measles patients had a 3.7 times higher risk of contracting the disease than those without contact.

Vaccination coverage of 95% or higher with two doses of a safe and effective measles vaccine provides substantial protection. However, disruptions due to the COVID-19 pandemic delayed the introduction of the second dose in many countries (WHO, 2023). Immunizing children at nine months is an effective way to prevent measles. Vaccination efforts have reduced measles-related deaths by 15.6 million (75%) in Indonesia (Ministry of Health, RI, 2015).

To reduce measles cases in South Halmahera, the Health Office and community health centers (Puskesmas) have implemented promotional and preventive efforts, including home visits to immunize unvaccinated infants. Routine immunization for infants, preschool children, and school-aged children needs to be enhanced. Public knowledge is strengthened through communication, information, and education materials. Community involvement is optimized through religious and community leaders and health cadres.

Given the background and ongoing measles cases and outbreaks, this study aims to investigate the factors associated with measles incidence among toddlers in South Halmahera in 2023.

"Do immunization status, nutritional status, exclusive breastfeeding history, and environmental sanitation influence measles incidence among toddlers in South Halmahera?"

The study's general objective is to analyze the factors influencing measles incidence among toddlers in the region. Specifically, it examines the relationships between each factor (immunization status, nutritional status, exclusive breastfeeding history, and environmental sanitation) and measles incidence.

The research is expected to provide both theoretical and practical benefits. Theoretically, it contributes to public health knowledge, particularly in measles prevention and control. It may also serve as a reference for future research. Practically, it offers insights for healthcare institutions to plan and prioritize measles prevention interventions. For the community, it provides additional information on factors influencing measles among toddlers.

Additionally, the study benefits local Puskesmas by enhancing early detection of measles cases, thereby preventing outbreaks. Findings can guide faster and more effective treatment for measles patients. For future researchers, this study serves as a reference or comparison in evaluating measles incidence and its influencing factors.

Methods

The research method is a structured approach applied in the research process. In its preparation, the research methodology must be explained in detail, including research variables, data collection techniques, data analysis, interpretation methods, and drawing conclusions (Nursalam, 2013).

Research Design

This study uses an observational analytic research type, which emphasizes rational research, focusing on the relationship between variables (Singarimbun, 1989). The study employs a case-control design, which is an epidemiological observation framework to study the relationship between exposure levels and various disease occurrences or other health problems. This design is based on observations of diseases that have already occurred, allowing for the analysis of two groups: the case group (individuals affected by the disease or outcome under investigation) and the control group (individuals not affected by the disease or outcome under investigation) (Nasri Noor, 2002).

Population and Sample

Population

The population in this study consists of all measles patients recorded in the measles registry, totaling 110 individuals residing in South Halmahera Regency.

Sample

The sample in this study includes measles patients aged under one to five years, registered in the measles registry in South Halmahera Regency in 2023. The sample ratio for cases and controls is 1:1, comprising 53 individuals as the case group and 53 individuals as the control group (non-measles patients). The samples are distributed across 15 public health centers (Puskesmas), with the unit of analysis being the parents of both the case and control groups.

The sampling technique used in this study is non-probability sampling, which means the sample is not selected randomly. The selection of population elements as samples may be incidental or influenced by predetermined factors planned by the researcher (Sugianto et al., 2020). The specific sampling technique applied is random sampling, where the selection of subjects is based on characteristics or traits considered to meet the predetermined criteria (Sugianto et al., 2020).

Result and Discussion

The results of the study aim to determine the relationship and odds ratio values of risk factors, and they were used to analyze the relationship between independent and dependent variables through statistical tests adapted to the available data scale. The statistical tests used were Chi-Square and determination of Odds Ratio (OR) with a 95% Confidence Interval (CI) and a significance level of 0.05. Below are the results of the bivariate analysis:

Table 1. Influence of immunization status on the incidence of measles

Immunization Status	Cases		Controls		R	95% CI	P
	n	%	n	%			
Not Immunized	38	71,7	10	18,9	4,92	1.612 -15.071	0,009
Immunized	15	28,3	43	81,1			
Total	**53**	**100,0**	**53**	**100,0**			

Source: Research Data Processing, 2024

The percentage of children with immunization status in the case group was 71.7%, which is higher than the control group at 18.9%. Children who were not immunized had a 4.92 times higher risk of contracting measles compared to children with complete immunization status. There is a significant relationship between immunization status and the occurrence of measles in children because the p-value = 0.009 < 0.05.

Table 2. Relationship between measles and exclusive breastfeeding history

Exclusive Breastfeeding History	Cases		Controls		R	95% CI	P
	N	%	N	%			
No	40	75,4	22	41,5	4,66	1.571-13.866	0,010
Yes	13	24,6	31	58,5			
Total	**53**	**100,0**	**53**	**100,0**			

Source: Research Data Processing, 2024

The percentage of children with no history of exclusive breastfeeding in the case group was 75.4%, higher than the control group at 41.5%. Children who were not exclusively breastfed had a 4.66 times higher risk of contracting measles compared to those who were exclusively breastfed. There is a significant relationship between the history of exclusive breastfeeding and the occurrence of measles in children because the p-value = 0.010 < 0.05.

Table 3. Relationship between measles and nutritional status

Nutritional Status	Cases		Controls OR		OR	95% CI	P
	N	%	N	%			
-3 SD sd < -2 SD	23	43,4	10	18,9	2,00	0,619-6,465	0,381
TB/BB -2 SD sd +1 SD	30	56,6	43	81,1			
Total	**53**	**100,0**	**30**	**100,0**			

Source: Research Data Processing, 2024

The percentage of children with a weight-for-height below -3 SD to < -2 SD in the case group was 43.4%, higher than the control group at 18.9%. Children with this nutritional status had a 2.00 times higher risk of contracting measles compared to those within the TB/BB -2 SD to +1 SD range. However, no significant relationship was found between nutritional status and the occurrence of measles in children because the p-value = 0.381 > 0.05.

ISSN 2721-1215 (Print), ISSN 2721-1231 (Online)

Table 4. Relationship between measles and the environment

Environment	Cases		Controls		R	95% CI	P
	N	%	N	%			
Unhealthy	32	60,4	10	18,7	5,50	1.813-16.681	0,004
Healthy	21	39,4	43	81,3			
Total	**53**	**100,0**	**30**	**100,0**			

Source: Research Data Processing, 2024

The percentage of children in unhealthy environments in the case group was 60.4%, higher than the control group at 18.7%. Children in unhealthy environments with measles had a 5.50 times higher risk of contracting measles compared to children in healthy environments. There is a significant relationship between exposure to an unhealthy environment and the occurrence of measles in children because the p-value = 0.004 < 0.05.

From the bivariate analysis, there are three variables that are candidates for logistic regression testing. The method used for logistic regression is Backward LR to identify the most dominant factor associated with the occurrence of measles. The variables included in the multivariate analysis are those with a p-value < 0.25, including: Immunization Status, History of Exclusive Breastfeeding, and Environmental Exposure to Measles, as shown in the table below:

Table 5. Variables associated with the occurrence of measles in children using logistic regression analysis

No	Value Variable	B	aOR	95% Cl	P	Information
1	Exlusive Breastfeeding	1.047	2.848	0.843-9.625	-092	Significant
2	Immunization Status	1.366	3.920	1.132-13.582	-031	Significant
3	Environment	1.440	4.220	1.244-14.315	-021	Significant
	Constanta	-1.830				

Source: Research Data Processing, 2024

Based on Table 5, the results of the multivariate analysis using the Backward LR method show that the most influential risk factors for measles are: 1) Children who did not receive exclusive breastfeeding have a 2.848 times higher risk of contracting measles compared to those who were exclusively breastfed (p-value 0.092). Thus, there is a significant relationship with the occurrence of measles in children (95% CI = 0.843 - 9.625); 2) Children with no immunization status have a 3.920 times higher risk of contracting measles compared to those with immunization status (p-value 0.031). Therefore, there is a significant relationship with the occurrence of measles in children (95% CI = 1.132 - 13.582); 3) Children in unhealthy environments with measles have a 4.220 times higher risk of contracting measles compared to those in healthy environments (p-value 0.021). Thus, there is a significant relationship with the occurrence of measles in children (95% CI = 1.244 - 14.315).

Factors Influencing Measles Incidence in Toddlers

This research, titled Analysis of Factors Influencing Measles Incidence in Toddlers Aged 0–59 Months, was conducted from August to September 2024 in South Halmahera Regency. Sample collection involved identifying the toddlers' ages, obtaining informed consent from their parents, and conducting interviews to fill out questionnaires.

Based on multivariate analysis using logistic regression tests, some independent variables showed statistically significant results with a p-value < 0.05, namely immunization status, exclusive breastfeeding, and environmental factors. These findings indicate an influence on the incidence of measles in toddlers aged 0–59 months in South Halmahera Regency. Meanwhile, other variables with a p-value > 0.05, such as nutritional status, were not found to have a

significant influence on the incidence of measles in toddlers aged 0–59 months in the same area.

Analysis of Immunization Status and Measles Incidence in Toddlers Aged 0–59 Months

Measles is a vaccine-preventable disease (VPD) caused by the *Morbillivirus*. It is characterized by symptoms such as fever, red spots, cough, runny nose, conjunctivitis (red eyes), and a rash that spreads across the body, often affecting children. Transmission occurs through airborne droplets contaminated by the secretions of infected individuals. Measles is a highly contagious disease that frequently leads to outbreaks (Dinkes Jatim, 2016; Berche, 2022; Torner et al., 2021).

The study results showed that, of the 53 case respondents with measles, 38 toddlers (71%) had not received measles immunization. Meanwhile, in the control group of 53 respondents, 10 toddlers (18.9%) had not received measles immunization. Statistical tests yielded a p-value of < 0.05 (0.009), leading to the rejection of the null hypothesis (Ho), indicating a significant relationship between immunization status and measles incidence in toddlers aged 0–59 months in South Halmahera Regency.

This finding aligns with research by (Lam et al., 2011), which states that measles immunization is a way to enhance immunity against measles. Immunization is an effective, practical, and relatively inexpensive method compared to the costs of treating the disease. Infants and young children are particularly vulnerable to measles.

According to Achmadi (2006), the purpose of measles immunization is to reduce the number of cases gradually each year, thus lowering morbidity and mortality rates. Among the case group, only 17 out of 43 toddlers (39.5%) had received measles immunization, compared to 32 out of 43 toddlers (74.4%) in the control group. Therefore, fewer children in the case group had received immunization compared to those who had not.

Immunization is the process of building immunity in humans to prevent and protect the body from damage caused by infectious diseases. It involves enhancing an individual's ability to fight specific pathogens. One method to improve immunity is through vaccination (Wulandari, 2021).

The Indonesian Ulema Council (MUI) (Dwilestari, 2019) states that immunization is permissible (mubah) as an effort to boost immunity and prevent specific diseases. However, vaccines used for immunization must be halal and pure. Vaccines derived from haram or impure materials are prohibited unless in emergency situations where no halal alternatives exist, as verified by trusted medical experts. If a lack of immunization could lead to death, severe illness, or permanent disability, immunization becomes obligatory. However, immunization should not be conducted if it is deemed harmful by experts.

Immunization is considered critical in emergencies, such as measles prevention, due to the disease's potential complications with other conditions like pneumonia. Vaccine failure is often caused by residual maternal antibodies during immunization or vaccine damage (Setiawan, 2008).

Chi-square test results show that toddlers with incomplete immunization status in South Halmahera Regency have a 4.92 times higher risk of contracting measles compared to those who are immunized. There is a significant relationship between immunization status and measles incidence in toddlers ($p = 0.009 < 0.05$). Logistic regression analysis also shows a significant relationship ($p = 0.031 < 0.05$) with an odds ratio (OR) of 3.920 (95% CI = 1.132–13.582). This indicates that toddlers without immunization are 3.92 times more likely to contract measles than those who are immunized.

Immunization is a key factor in measles prevention, as many parents reported delaying immunization due to their child being unwell at the scheduled time. This delay leads to inadequate immunity, making unvaccinated toddlers more susceptible to measles transmission.

Analysis of Exclusive Breastfeeding History on Measles Incidence in Children Aged 0–59 Months

The study results showed that among 53 measles case respondents, 40 children (41.5%) did not receive exclusive breastfeeding. Meanwhile, among 53 control respondents, 22 children (18.9%) did not receive exclusive breastfeeding. Statistical testing revealed a p-value < 0.05 (0.010), rejecting the null hypothesis (Ho), indicating that exclusive breastfeeding has a significant impact on measles incidence among children aged 0–59 months in South Halmahera Regency. These findings align with research by Agus et al. (2019), which demonstrated a relationship between the lack of exclusive breastfeeding and measles incidence in children.

Exclusive breastfeeding, along with vitamin A supplementation, is a mandatory health service program for toddlers. Exclusive breastfeeding coverage in Padang City is 76.52%, with vitamin A supplementation at 95.6%. Ardiyanto (2016) found that children not exclusively breastfed are 6.88 times more at risk of developing measles compared to those exclusively breastfed.

Breast milk (ASI) is essential for infants aged 0–6 months, containing antibodies against various viruses and proven to inhibit their growth. Colostrum neutralizes the Respiratory Syncytial Virus (RSV) and provides protection via mechanisms such as enhancing non-pathogenic microorganisms, reducing pathogenic microorganisms, stimulating mucosal barrier development in the digestive and respiratory tracts, and delivering immune factors like secretory IgA and immune cells. These factors explain why exclusive breastfeeding is a critical risk factor in preventing measles.

A Chi-square test showed that non-exclusively breastfed children had a 4.66 times higher risk of measles than exclusively breastfed children (p = 0.010 < 0.05). Logistic regression analysis further revealed a 2.84 times greater risk for children not exclusively breastfed (95% CI = 0.843–9.625). The lack of exclusive breastfeeding until six months was identified as a factor weakening immunity, making children more susceptible to infections such as measles.

Analysis of Nutritional Status on Measles Incidence in Children Aged 0–59 Months

Analysis of children with good nutritional status showed a p-value of 0.381, accepting Ho, indicating no significant relationship between nutritional status and measles incidence in children. This contrasts with Agus et al. (2019), who suggested that poor nutritional status influences measles incidence as it weakens immunity, making infections like measles more likely.

Khunsul (2008) noted that measles was more prevalent (80.8%) among children with good nutritional status compared to those with poor nutritional status (19.2%). Poor nutritional status, however, can impair vaccine efficacy and immune response due to reduced cellular immunity, low humoral specificity, and decreased macrophage mobilization (Wahab, 2002).

While this study found no direct link between nutritional status and measles, malnourished children may have compromised immunity, increasing measles susceptibility. Nutritional deficiencies like vitamin A exacerbate measles severity and complications. Conversely, measles infections can affect nutritional status through appetite loss, vomiting, or diarrhea, causing weight loss and deficiencies. Thus, good nutritional status is crucial for maintaining strong immunity and minimizing infection risks.

Analysis of Environmental Impact on Measles Incidence in Children Aged 0–59 Months

Analysis revealed environmental factors as the most dominant external determinant, with a significant impact on measles incidence (p < 0.05). Poor sanitation—such as limited access to

clean water, inadequate hygiene, and unsanitary conditions—promotes the transmission of measles by fostering the virus's spread and weakening immunity.

Environmental factors include physical, biological, and social conditions influencing daily life. Purnama (2017) emphasized the interconnectedness of humans and their surroundings, highlighting the role of sanitation in preventing diseases like measles. Poor environmental conditions not only increase measles transmission risks but also reduce immune resilience, making children more vulnerable.

Conclusion

Based on the research results, it can be concluded that there is no significant relationship between the age at the time of measles vaccination and the occurrence of measles in children (p = 0.288; OR = 2.04). However, there is a significant effect of immunization status (p = 0.009; OR = 4.92) and exclusive breastfeeding (p = 0.010; OR = 4.66) on the occurrence of measles. Meanwhile, nutritional status does not show a significant effect (p = 0.381; OR = 2.00). Environmental factors, especially unhealthy environments, have a significant effect on the occurrence of measles (p = 0.004; OR = 5.50), with unhealthy environments being the most dominant risk factor. These findings highlight the importance of maintaining a healthy environment, complete immunization status, and exclusive breastfeeding to prevent measles in children.

References

Berche, P. (2022). History of measles. *La Presse Médicale*, *51*(3), 104149. https://doi.org/10.1016/j.lpm.2022.104149

Dwilestari, I. (2019). Analisa Minat Orang Tua Dalam Pemberian Vaksin MR Setelah Putusan MUI:(Studi di Kecamatan Metro Pusat Tahun 2018). *At-Tahdzib: Jurnal Studi Islam Dan Muamalah*, *7*(1), 70–84.

Fatimah Ramadhani, N., Bejo Raharjo, S. K. M., & Werdani, K. E. (2016). *Hubungan Status Imunisasi dan Riwayat Kontak dengan Kejadian Campak Pada Balita di Kabupaten Sukoharjo*. Universitas Muhammadiyah Surakarta.

Javanian, M., Barary, M., Ghebrehewet, S., Koppolu, V., Vasigala, V., & Ebrahimpour, S. (2021). A brief review of influenza virus infection. *Journal of medical virology*, *93*(8), 4638-4646. https://doi.org/10.1002/jmv.26990

Kemenkes, R. I. (2018). Data dan Informasi Profil Kesehatan Indonesia 2018. *Jakarta: Kemenkes RI*.

Kurniasih, A., Lubis, S. A., & Damanik, R. Z. (2024). Karakteristik Kejadian Campak Pada Anak Di Rsud Dr. Fauziah Kabupaten Bireuen Tahun 2022. *Jurnal Kedokteran STM (Sains dan Teknologi Medik)*, *7*(1), 24-32. https://doi.org/10.30743/stm.v7i1.493

Lam, S. K., Burke, D., Capeding, M. R., Chong, C. K., Coudeville, L., Farrar, J., Gubler, D., Hadinegoro, S. R., Hanna, J., & Lang, J. (2011). Preparing for introduction of a dengue vaccine: recommendations from the 1st Dengue v2V Asia-Pacific Meeting. *Vaccine*, *29*(51), 9417–9422. https://doi.org/10.1016/j.vaccine.2011.08.047

Leung, N. H. (2021). Transmissibility and transmission of respiratory viruses. *Nature Reviews Microbiology*, *19*(8), 528-545. https://doi.org/10.1038/s41579-021-00535-6

Nursalam, S. (2013). Metodologi penelitian ilmu keperawatan pendekatan praktis. *Jakarta: Salemba Medika*.

Ponidjan, T. S., Kep, M., & An, N. S. K. (2024). BAB 7 Konsep Imunisasi Dasar. *Bunga Rampai Konsep Dan Masalah Kesehatan Anak*, 80.

Prabowati, E., Bejo Raharjo, S. K. M., & Wijayanti, A. C. (2016). *Hubungan Antara Pemberian Asi Eksklusif Dan Pengetahuan Ibu Dengan Kejadian Campak Pada Balita Di Kabupaten Sukoharjo*. Universitas Muhammadiyah Surakarta.

Rahmayanti, L. M. (2015). Hubungan Status Imunisasi Campak dan Perilaku Pencegahan Penyakit Campak dengan Kejadian Campak pada Bayi dan Balita di Puskesmas Kaabupaten Bantul Tahun 2013-2014. *Ekp*, *13*(3), 1576–1580.

Rifani, M., Pelupessy, N. M., Artati, R. D., & Baso, A. J. A. (2024). Divisi Infeksi dan Penyakit Tropis Infeksi Measles Pada Anak Perempuan 3 Tahun. *Jurnal Ners*, *8*(1), 109-121. https://doi.org/10.31004/jn.v8i1.20190

Ringo, N. L. S., Kep, M., An, S. K., Hastuti, D., Metri, N. D., Sari, R. M., & Sari Octarina Piko, S. K. M. (2022). *Buku Ajar Anak DIII Keperawatan Jilid I*. Mahakarya Citra Utama Group.

Setiawan, I. M. (2008). Clinical and laboratory aspect of leptospirosis in humans. *Universa Medicina*, *27*(2), 87–97. https://doi.org/10.18051/UnivMed.2008.v27.87-97

Sugianto, D., Suwartono, C., & Sutanto, S. H. (2020). Reliabilitas dan validitas self-compassion scale versi Bahasa Indonesia. *Jurnal Psikologi Ulayat*, *7*(2), 177–191. http://dx.doi.org/10.24854/jpu107

Sumampouw, O. J., & Nelwan, J. E. (2024). *Dasar Kesehatan Lingkungan Konsep Dasar Dan Pencemaran Lingkungan*. Deepublish.

Torner, N., Ferràs, J., Curto, L., Rebull, J., Sol, J., Costa, J., ... & Jané, M. (2021). Measles outbreak related to healthcare transmission. *Vacunas*, *22*(1), 20-27. https://doi.org/10.1016/j.vacun.2020.08.002

WHO. (2023). *Measles - Indonesia*. https://www-who-int.translate.goog/emergencies/disease-outbreak-news/item/2023-DON462?_x_tr_sl=en&_x_tr_tl=id&_x_tr_hl=id&_x_tr_pto=tc

WHO. (2024). *Cakupan imunisasi*. https://www-who-int.translate.goog/news-room/fact-sheets/detail/immunization-coverage?_x_tr_sl=en&_x_tr_tl=id&_x_tr_hl=id&_x_tr_pto=tc

WHO. (2024). *Kasus campak meningkat di seluruh dunia, menginfeksi 10,3 juta orang pada tahun 2023*. https://www-who-int.translate.goog/news/item/14-11-2024-measles-cases-surge-worldwide--infecting-10.3-million-people-in-2023?_x_tr_sl=en&_x_tr_tl=id&_x_tr_hl=id&_x_tr_pto=tc

Widayat, A., Fatkul Munir, S. K. M., Alis, N., KM, S., & KM, M. (2014). *Faktor-faktor yang berhubungan dengan pneumonia pada balita di wilayah puskesmas mojogedang II kabupaten karanganyar*. Universitas Muhammadiyah Surakarta.

Wulandari, D. (2021). *Faktor-faktor yang berhubungan dengan pemberian imunisasi Meales Rubella (MR) pada balita di Wilayah kerja Puskesmas MU Damanik Kota Tanjungbalai*. Universitas Islam Negeri Sumatera Utara.

Yalpira, B. (2024). *Hubungan Status Imunisasi Dengan Kejadian Komplikasi Pada Pasien Campak Anak Di Rsud Raden Mattaher Jambi Tahun 2022 Dan 2023* (Doctoral dissertation, UNIVERSITAS JAMBI).

Yonanda, V. (2022). Tatalaksana Campak. *Jurnal Medika Hutama*, *3*(02 Januari), 1987–1991.