DETERMINANTS OF MEASLES RESURGENCE IN SOUTHEAST ASIAN COUNTRIES :

A SCOPING REVIEW

Manuscript Info

Manuscript History
Received: xxxxxxxxxxxxxxx
Final Accepted: xxxxxxxxxxx
Published: xxxxxxxxxxxxxxx

Key words:
Measles, Immunization, Vaccination, Outbreak, Southeast Asia, Vaccine Management, Herd Immunity

Abstract

Measles remains a significant public health concern in Southeast Asia, with a resurgence of cases in recent years despite the availability of an effective vaccine. This scoping review aimed to identify immunization factors contributing to the increase in measles cases in the region between 2020 and 2025. A systematic literature search was conducted in Scopus, PubMed, and Garuda databases, yielding 27 eligible articles for review. Inclusion criteria focused on studies conducted in the Southeast Asia region, articles published between 2020-2025, full text, with discussions covering five main variables: Immunization Status, Knowledge, vaccine management, vaccine effectiveness, and public perception of immunization. All selected data were extracted and analyzed descriptively. The Findings consistently showed that children who were not immunized or had an incomplete immunization history had a 29.96 times greater risk of measles compared to those who were fully immunization. Low parental knowledge about vaccination, suboptimal vaccine management in cold chain, distribution, and storage, declining vaccine efficacy over time, and negative perceptions towards immunization due to cultural and religious beliefs also contribute to the increase in measles cases. Serological studies indicated that even with high two-dose measles vaccination coverage, optimal herd immunity may not be achieved, suggesting the need for considering a third dose. Improving public education, vaccine management systems, public trust in immunization and involving community leaders, are crucial for effective measles control. A multidimensional approach focusing not only on increasing vaccination coverage but also addressing these factors is necessary to reduce measles incidence and prevent future outbreaks in Southeast Asia.

Introduction

Measles is a systemic infectious disease caused by a single-chain ribonucleic acid virus (Measles Virus) of the Paramyxovirus family. Measles is also known as morbilli which causes infection of the respiratory system, and the immune system. Measles is a highly contagious viral infection with substantial morbidity and significant mortality. (Naim H. Y. 2015)[1].

Based on the WHO report, in 2023 measles cases in the world jumped dramatically to reach 10.3 million cases (an increase of 20% compared to 2022), and has resulted in 107,500 children dying from measles (WHO, 2024)[2]. Indonesia still ranks as the 10th highest measles prevalence in the world. In 2023, there were 39,360 measles cases spread across all provinces in Indonesia. The number of cases almost doubled compared to the number of measles cases in 2022 of 21,175 cases. Throughout 2023, there were 137 suspected measles outbreaks in 24 provinces with a total of 2,268 cases, an almost two-fold increase compared to the 79 suspected measles outbreaks in 2022 in 18 provinces with a total of 1,101 cases. Of the 38 provinces, 11 provinces experienced measles outbreaks in 2022 and 2023, namely North

Sumatra, West Sumatra, Riau, Jambi, West Java, East Java, Banten, North Kalimantan, South Sulawesi, Maluku and Papua. (Indonesian Ministry of Health. 2023)[3].

Measles can be prevented through immunization with measles vaccine or MMR (Measles, Mumps, Rubella) vaccine. Mumps, Rubella). According to the 2014 IDAI recommended immunization schedule, measles vaccine is given at 9 months of age. Furthermore, the booster vaccine can be given at the age of 2 years. If the MMR vaccine is given at 15 months of age, there is no need for measles vaccination at 2 years of age. Subsequently, repeat MMR is given at 5-6 years of age.13 The dose of measles vaccine or MMR vaccine is 0.5 mL subcutaneously (Halim. R.G, 2016)[4].

In achieving optimal coverage, the successful implementation of the immunization program is influenced by 2 (two) main aspects. The first aspect is technical and managerial factors in health services such as adequate vaccine availability, easy access to immunization services both in terms of location and time, availability of competent health workers, work motivation and good recording and reporting systems. The second aspect is community acceptance of immunization services which is influenced by logistical management needs, readiness of health workers, and other factors such as beliefs, customs or culture (Afriyanti, 2009)[5].

Providing immunization to children or toddlers can trigger the formation of herd immunity and strengthen the immune system, which in turn can reduce the rate of transmission of infection and increase life expectancy. (Ningtyas & Prabowo, 2015)[6]. Although immunization has been implemented, there are still toddlers who have not received basic immunizations, including measles immunization. This condition may be caused by managerial aspects of health services as well as socio-economic and community perceptions. Based on this background, researchers are interested in conducting research through literature review journals to identify what immunization factors are predictors of increased measles cases.

Methods

This coverage review was conducted based on the methodological framework proposed by Arksey and O'Malley, refined by Tricco et al. (2018) and guided by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR).

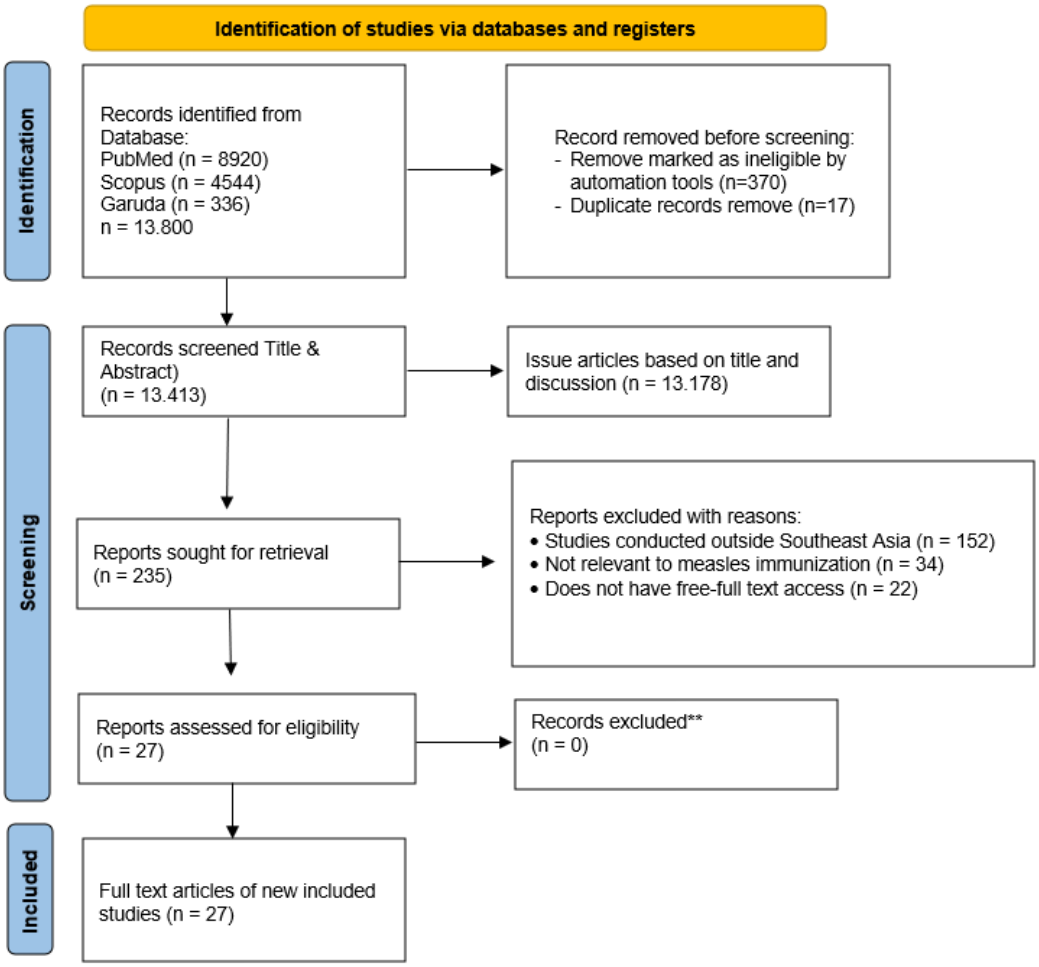
The aim of this review was to determine immunization risk factors as predictors of increased measles cases in Southeast Asia over the period 2020 to 2025. A systematic literature search was conducted in three databases: Scopus, PubMed, and Garuda. The search strategy combined keywords in Scopus and PubMed as (Measles OR "Morbilli") AND ("Measles AND Vaccine" OR Vaccination OR Immunization") AND ('Measles AND Outbreak"), in Garuda the keyword was Measles. The search was restricted to articles published between 2020 and 2025, written in English or Bahasa Indonesia, and freely available in full text.

All retrieved articles were imported into Mendeley Reference Manager to remove duplicate articles. Two independent reviewers screened titles and abstracts for initial selection. Potentially relevant articles were assessed in full-text format. Any discrepancies between reviewers were resolved through discussion. Data from eligible studies were extracted using a Microsoft Excel data chart form, including the following information: Authors, Year of publication, Location, Objectives, Methods, Immunization status, Parental knowledge, Vaccine management, Vaccine efficacy and Community perception. The extracted data were analyzed descriptively and presented through thematic narrative synthesis and summary tables. A PRISMA-ScR flow chart was used to illustrate the study selection process.

Figure 1. PRISMA ScR flowchart of selection process

Results

The results of the literature search conducted through the Scopus, PubMade and Garuda databases in accordance with keywords and topics, found a total of 13,800 articles. Subsequently filtered by duplication which removed 387 duplicate articles, leaving 13,413 articles to be filtered by title and abstract. Of these, 235 articles were selected for full review, but 208 articles were



eliminated because they did not meet the inclusion criteria, resulting in 27 articles for review. The article selection process is described in the PRISMA Scooping Review flowchart (Figure 1) above, while a summary of the main characteristics or findings of the reviewed articles is presented in Table 1.

Immunization Status

Most of the studies in this review showed that immunization status had a significant association with increased measles incidence. Children who were not immunized against measles or whose immunization status was incomplete had a 4 times or even 29.96 times greater risk of contracting measles, such as the results of studies conducted in Aceh and Muna districts[7,8].

However, in some areas with administratively high immunization coverage, measles cases are still reported in large numbers. This indicates the possibility of inaccurate coverage data or the presence of population groups that have not been evenly reached[9]. Therefore, immunization coverage cannot be the only indicator of the success of immunization programs, but must also consider the distribution and quality of implementation in the field. These findings emphasize the importance of routine immunization, including the administration of follow-up doses (MCV2), as well as verification of immunization status by individual through active surveillance to increase herd immunity and prevent outbreaks.

Parental Knowledge

A total of nine articles revealed that low parental knowledge of the importance of measles immunization was a major limiting factor in immunization coverage. A study conducted in Solok City showed that a lack of understanding of the benefits of, and schedule for, immunization contributed to low parental participation in bringing children to health facilities[10].

This suggests that parents' ignorance of the immunization schedule, lack of understanding of the benefits of immunization in preventing serious complications from measles, and misperceptions about the side effects of immunization are factors that influence children not to be immunized. Therefore, community-based health promotion with an easy-to-understand edukatof approach is needed to improve immunization literacy in the community.

Vaccine Management

Five articles discussed aspects of vaccine management as an important component of the measles immunization program. Problems that arose included cold chain disruption, vaccine distribution logistics, and the availability of competent health workers. The results showed that not all health facilities in remote areas have standardized vaccine refrigerators, increasing the risk of vaccine potency decline[9]. Research in Myanmar and Laos showed that manual recording and lack of digital monitoring systems led to inconsistencies in immunization data, which resulted in inaccurate interventions[11,12]. The problem of limited immunization officers was also mentioned in several studies as a cause of obstacles to the implementation of immunization programs in border areas or small islands[10].

Vaccine Efficacy

Laos, Vietnam and Thailand showed that the level of seropositivity of antibodies to measles virus decreased over time, even in individuals who had received two doses of vaccine[13,14,15]. Vaccine efficacy is influenced by various factors, such as age at vaccination, spacing between doses, and the quality and technique of injection[9]. This decrease in immunity opens up the possibility of primary and secondary vaccine failures, resulting in an increase in measles cases. Therefore, long-term monitoring of vaccine effectiveness is necessary, including considering the administration of a third dose (MCV3) in age groups that are susceptible to losing immunity[16,15]. Strengthening national serologic surveillance is important to obtain a true picture of the population's level of immunity to measles.

Community perceptions

Twelve articles revealed that negative perceptions of immunization are still a major barrier, even though vaccines are freely available. These perceptions are formed due to various factors, such as the influence of cultural and religious beliefs, bad experiences related to immunization side effects, and the spread of misinformation through social media[17]. Research results in Indonesia show that anti-immunization narratives circulating among certain religious communities can cause a

significant decline in immunization coverage in an area. Meanwhile, studies in Thailand and Lao PDR also identified public distrust of the government or health workers due to weak risk communication[18,19]. Qualitative studies suggest that such mistrust can be overcome through community-based approaches and the involvement of community leaders in immunization-related education[20].

Table 1. Summary of findings

Author	Location	Objective	Status Immunization	Knowledge	Vaccine Management	Vaccine Efficacy	Community Perception
Janna et al. 2023	Aceh, Indonesia	To assess how measles immunization, maternal knowledge, and education affect measles risk in children under five.	Significant (p=0,010; PR=4,000; 95%CI = 1,392–11,497)	Significant (p=0,009; PR=7,692 95% CI = 1,071–55,227)	-	-	-
Delvina et.al 2023	Solok City, Indonesia	To analyze factors affecting low follow-up measles immunization coverage among children aged 18-36 months	Low (only 3.1%)	Very less, do not know the follow-up immunization or its schedule	Human resources and facilities suffice, but lack policy support & knowledge	-	Negative perceptions: AEFI fears, haram vaccine issues, social media hoaxes
Falawati, WF 2020	Muna Regency, Indonesia	To determine the relationship between immunization status and immunization officers with measles incidence in Muna District	P = 0,571 OR = 29.96; 95% CI = 10.17-88.27)	-	-	-	-
Harahap et al. 2021	Aceh Singkil, Indonesia	to Analyze Islamic and health views on measles immunization in toddlers at Puskesmas Simpang Kanan District Simpang Kanan	82.5% no vaccine	Significant p = 0,000	-	Significant P = 0,006	Many mothers fear haram issues or post-immunization adverse events (AEFI).
Riastini & Sutarga 2021	Badung Regency, Bali, Indonesia	To know measles incidence in Badung Regency during 2014-2019	The majority of measles cases occur in immunized children (e.g. 87.75% in 2015).	Cold chain, injection techniques, and non-optimal immunization implementation are suspected influences	Primary/secondary vaccine failure due to age of administration, antibody resistance, and vaccine dose	-	-
Rahadatunnisa et al 2023.	Banda Aceh, Indonesia	To determine the association of age, nutrition and immunization status with measles in children aged 0-5 years	Significant OR = 7,800	-	-	-	-
Rahayu, et.al 2020	Purwokerto, Banyumas Indonesia	for Measles Outbreak Investigation in Purwokerto City, Banyumas Regency,	Significant OR = 9,59; CI 95%: 3,58–25,72; p = 0,01	-	-	70% = Still below standard	-

Author	Location	Objective	Status Immunization	Knowledge	Vaccine Management	Vaccine Efficacy	Community Perception
Miniharianti et al. 2024	Banda Aceh, Indonesia	To determine how immunization completeness relates to measles severity	Significant p = 0,000	-	-	-	-
Husna, et.al 2021	Sabang City Indonesia	Determine the effect of maternal knowledge and attitudes on measles immunization follow-up during COVID-19		Significant OR = 8.000 95% CI= 1.005–63.673) p = 0,035	-	-	-
Hendrati & Hamzah 2023	Indonesia	to determine the relationship between measles cases across all provinces	Significant **2018 :** (p = 0,000 r = 0,646–0,942) **2019** : p = 0,000 r = 0,942 **2020 :** p = 0,000 r = 0,934,	-	-	-	-
Fazlaini, R. 2020	Pidie Jaya Indonesia	To determine measles immunization's association with measles incidence among children aged 2-5 years	Significant p = 0,012	Mothers' lack of knowledge affects measles immunization for toddlers	-	-	the issue of non-halal vaccines (containing lard)
Qamruddin et al. 2020	Perak, Malaysia	Determine factors and incidence of confirmed measles cases	Significant OR = 1,98, 95% CI: 1,42–8,83; p = 0,012	-	-	-	vaccine refusal due to religious and safety (AEFI) reasons
Xaydalasouk et al 2021	Saravan, Laos	to Determine exposure and immunity to vaccine-preventable infectious diseases by age	-	-	-	p < 0.0001 OR 145,9	-
Hachiya et al 2024	Vietnam	To assess IgG prevalence against measles and rubella by age, and routine and supplemental immunization impact	Significant OR 3,26 95% CI: 1,58–6,74 p < 0,001	-	-	Low Efficacy IgG positive only 66.5%	-
Takkinsatian et al 2024	Nakhon Nayok, Thailand	Determine measles seroprevalence & evaluate protection by age and vaccination	• Usia 2,5 tahun: seropositif 82% (CI 73,3–90,7) • usia 5–15 th (2 dosis): hanya 50% sero positif	-	Cakupan Relatif rendah, yaitu 90%	signifikan usia: p < 0,001 Usia 5–29 tahun, seropositif hanya 50–52%	-

Author	Location	Objective	Status Immunization	Knowledge	Vaccine Management	Vaccine Efficacy	Community Perception
Mehra et al 2025	Thailand	to Identify measles immunity & determine the ideal age to administer the 3rd dose of MCVs	Overall seropositivity 65.6% 95% CI: 61.5-69.6 age 21-30 yrs 54.3% (47.6-61.1)	-	Low coverage MCV1 coverage: 93%; MCV2: 87%	Duration of vaccine immunity 15.3 years (95% CrI: 10.8-20.2); 50% seronegative achieved at 18-20 years of age	
Kusuma, et.al 2023	Banten Indonesia	To analyze the influence of parents' perceptions on children's MMR immunization decisions using protective motivation theory.	-	-	-	OR = 3.213 p =0.006	Significant $p < 0.05$
Harapan et al. 2021	Indonesia	to Analyze the influence of religion on measles vaccination status among children in Indonesia	Significant OR = 0.82 (Muslim vs non-Muslim); 95% CI: 0.75-0.90 $p < 0.001$	-	-	-	Faith-based perceptions influence vaccination decisions
Ng et al 2020	Singapore	to Assess seroprevalence of vaccine-preventable diseases in children and adolescents in Singapore	Significant OR=3.45, 95% CI=2.10-5.68, p<0.001			OR=4.10, 95% CI=2.80–6.01, p<0.001	
Zhong et al. 2021	Singapore	to Assess the impact of the COVID-19 pandemic on child immunization coverage in Singapore	$p < 0.001$	-	$p < 0.01$)	-	Negative public perception of the risk of COVID-19 affects the decline in vaccination visits
Jinarong et al. 2023	Thailand	to explore Muslim parents' beliefs and factors influencing complete immunization of children aged 0-5 years	Only 64% of children are immunized	Negative beliefs are barriers that cause vaccine hesitation and rejection	-	-	Religious perceptions, culture, and vaccine concerns influence vaccination decisions
Salleh, et.al 2025	Sabah, Malaysia	to Evaluate the effectiveness of community-based interventions in improving immunization campaigns	OR: 2.45, 95% CI: 1.62–3.71, $p < 0.001$)	OR: 1.88, 95% CI: 1.22–2.91, $p = 0.004$)	$p < 0.01$	-	$p = 0.03$

Author	Location	Objective	Status Immunization	Knowledge	Vaccine Management	Vaccine Efficacy	Community Perception
Ichimura, et.al 2022	Laos	to Identify determinants of immunization coverage in children aged 12-35 months	p = 0,02	OR: 1.64, 95% CI: 1.22–2.20, p = 0.001	OR: 0.65, 95% CI: 0.48–0.89; p = 0.007		OR: 1.81, 95% CI: 1.31–2.49, p <0.001
Win, et.al 2022	Myanmar	to Assess equity of access and distribution of benefits of immunization among children in Myanmar	OR: 2.03, 95% CI: 1.41–2.91, p <0.001	-	Significant differences in facility access and vaccine distribution between regions and socioeconomic quintiles	-	Perceptions are influenced by socio-economic status and trust in the local health system
Wongsanuphat, et.al 2020	Nakhon Pathom, Thailand	to Investigate outbreak campaigns among local and migrant workers, and identify their risk factors	OR: 5.68, 95% CI: 1.88–17.13; p = 0.002	Problems with immunization records in migrant workers and lack of vaccination documentation	-	-	Migrants show low trust in formal health services and vaccination programs
Kumar, et.al 2023	Malaysia	to Evaluate effective vaccine coverage by considering correlation between dose & efficacy	-	-	-	93.5% (95% CI: 92.2–94.7%), r = 0.45	-
Ang, et.al 2022	Singapore	to Assess the level of susceptibility to measles among migrant workers	OR: 2.93 (95% CI: 1.94–4.42), p <0.001				

Discussion

Immunization status is one of the main determinants of protection against measles. Children who are not immunized against measles or only receive one dose have a much higher risk of developing measles. Based on the results of research by Falawati (2020) in Indonesia[8], showing an Odds Raio (OR) value of 29.96, this is in line with the results of research by Rahayu et.al (2020)[21], which reported an OR value of 9.59. This indicates that children with a history of incomplete immunization status have a very high probability of suffering from measles disease compared to children who have received a complete dose of measles immunization.

On the other hand, the results of serological studies conducted in Thailand and Laos show that the coverage of two-dose measles immunization has not been fully effective in forming optimal herd immunity. A study conducted by Takkinsatian et.al (2024) in Thailand, reported that only 59.1% of respondents had positive IgG antibodies against measles, even though measles immunization coverage was in the good category[15]. This suggests that the presence of maternal antibodies may hinder the effectiveness of the vaccine by inadequate dosing or too early implementation of measles immunization.

In terms of providing measles immunization to children, mothers are the main decision makers in immunization. Maternal knowledge has been shown to have a significant contribution to the success of the immunization program. The low

level of knowledge about measles immunization, the timing of immunization, the benefits and urgency of follow-up immunization are the main obstacles most often faced. The results of a study by Janna et.al (2023) reported that most mothers of children who had not been immunized did not know the schedule for follow-up immunization and had never even received education from health workers[7].

Similar research conducted by Husna et.al. (2021) showed that a good level of knowledge significantly increased parental participation in the implementation of the immunization program[22]. This finding emphasizes the importance of continuous, consistent and continuous education to the community, especially to mothers or caregivers of children, so that they have a complete understanding of the importance of complete and timely immunization.

Vaccine management includes aspects of storage, distribution, dispensing and implementation of vaccine administration by health workers. Technical problems such as errors in cold chain management, incomplete records, and the limited number of health workers, contribute to the optimal implementation of immunization. Riastini and Sutarga (2021) reported that measles cases still occur even though children have received complete immunization. This condition is most likely due to the storage of vaccines that are not according to standards or errors in injection techniques[9].

In addition, studies in Thailand and Malaysia have shown that immigrant and refugee groups often lack complete vaccine documentation. This makes it difficult for officials to assess their vaccine status (Wongsanuphat, et.al. (2020)[19]. These findings emphasize the need for an accurate and comprehensive immunization recording system, as well as the need to improve the technical capacity of health workers.

Measles vaccines are theoretically highly effective, but some studies have shown that protection levels may decline over time. The study by Hachiya et.al. (2024) reported that only 66.5%

Tinjauan ini menyimpulkan bahwa faktor This review concludes that immunization factors are a major determinant in the increase of measles cases. Incomplete immunization status was consistently found to be the most dominant risk

of adolescents and young adults had IgG antobodies to measles, despite previous vaccination[14].

Based on the results of Mehra et.al. (2025) stated that post-immunization immunity is likely to last about 15 years[16]. This phenomenon is a challenge in countries that have not implemented the third dose of vaccine (booster). Thus, vaccine effectiveness is also influenced by age at first immunization, individual immune response and the possibility of viral genetics. Some countries have considered the addition of a third dose as a strategic effort to close the immunity gap due to declining antibody levels over time.

Public perceptions of measles immunization have a major influence on the success of vaccination programs. Beliefs about vaccination, cultural values and the influence of social media are factors that strongly influence people's decision to accept immunization. Rejection of immunization is often based on the belief that vaccines contain unclean ingredients, concerns about side effects, and or the assumption that immunization is not needed when the child looks healthy.

Based on research by Delvina et.al (2023) and Kusuma et.al (2023) stated that negative perceptions of vaccines are one of the main causes of refusal of immunization in a number regions in Indonesia[23,24]. The COVID-19 pandemic has also worsened the condition, as many parents are unwilling to visit health facilities for fear of contracting the virus, as the results of a study conducted by Zhong et.al (2021)[25].

In addition, low trust in the health care system, lack of involvement of community leaders, and lack of socialization and education contribute significantly to public hesitation. Studies in Malaysia and the Philippines emphasize the important role of communication from health authorities and the involvement of religious leaders in educating the public to increase trust and reduce doubts about immunization programs (Ng. et.al., 2020; Jinarong et.al., 2023)[26,18].

Conclusion

factor. In addition, low public knowledge, suboptimal vaccine management, declining vaccine efficacy, and negative perceptions of immunization have also contributed to the increase in measles cases.

Therefore, measles control efforts must be carried out with a multidimensional approach and not only focus on increasing vaccination coverage, but also increasing public education, strengthening vaccine management systems and increasing public understanding and trust in immunization.

This holistic approach is expected to reduce the incidence of measles and prevent future extraordinary events.

Ethics approval
Not applicable.

Availability of data and materials
Not applicable.

Acknowledegment
The authors would like to thank the Master of Epidemiology Study Program, Faculty of Public Health, Diponegoro University for the academic support provided. Appreciation is also expressed to the Maluku Provincial Health Office for providing valuable support and input. The authors also express their gratitude to friends who have helped in the process of preparing this scooping review. Special thanks go to the editors and reviewers for their input on this manuscript.

Funding
Not applicable

Author Contribution
All authors contributed substantially to the process of preparing this scooping review, such as the process of wetting the topic, developing research questions, and drafting the protocol collaboratively. IA conducted the literature search, study selection, and data extraction. FM provided substantive input in the form of thorough scientific supervision of the findings, critical review of the findings, analysis and refinement of the manuscript and approval. All authors read and approved the final manuscript for publication.

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