Behavioral Factors and Practices of Multiple Injection Immunization for Children Aged 9-12 Months in Rural Areas

Ayun Sriatmi*[1], Setyo E. Pratiwi[2], Farid Agushybana[3]

[1] Department of Health Policy and Administration, Universitas Diponegoro, Semarang, Indonesia
[2]Division of Disease Prevention and Control, District Health Office of Kendal District, Kendal, Indonesia
[3]Department of Biostatistic and Demography, Universitas Diponegoro, Semarang, Indonesia

DOI: 10.24252/al-sihah.v16i1.45525
Received: 8 February 2024 / In Reviewed: 15 June 2024 / Accepted: 26 June 2024 / Available online: 28 June 2024

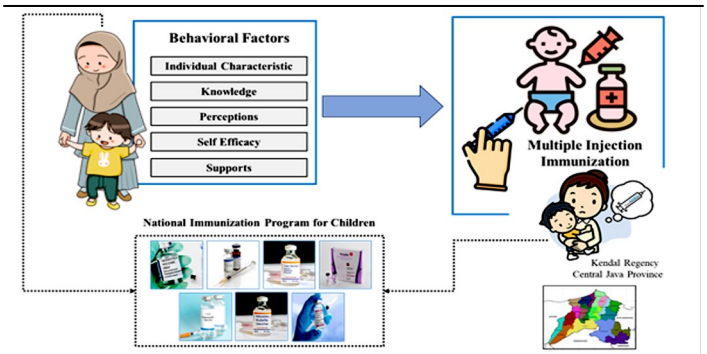
ABSTRACT

Immunization has been proven to be cost-effective and globally successful in reducing child deaths from infectious diseases. However, the many types of vaccines that must be given to each child in one visit make this practice controversial because they are considered unsafe. The study aims to analyze behavioral determinants of multiple injection immunization practices in rural areas. This is analytical research with a quantitative and cross-sectional approach. The population consists of all children aged 9-12 months in Kendal Regency with a sample of 407 children. Respondents were parents/caregivers selected from 30 PHC. Data were collected by interview using a questionnaire that had been tested for validity and reliability. Immunization practices are assessed through the Maternal and Child Health-Book. Immunization practice with multiple injections is partially related to education, knowledge, perception (susceptibility, severity, side effects, benefits), self-efficacy, and support (family, health workers, community, informational, and policy). Simultaneously, it is known that health worker support has the most dominant influence, followed by informational support, knowledge, perceived severity, and perceived susceptibility. Efforts are needed to increase health workers' competency in reducing the pain of children due to vaccination, as well as providing education to parents/caregivers effectively through clear communication, reducing misinformation and misperceptions, especially for rural communities.

ABSTRAK

Imunisasi telah terbukti hemat biaya dan berhasil secara global dalam mengurangi kematian anak akibat penyakit menular. Namun banyaknya jenis vaksin yang harus diberikan kepada setiap anak dalam satu kali kunjungan membuat kondisi ini menjadi kontroversi karena dianggap tidak aman. Penelitian ini bertujuan untuk menganalisis faktor-faktor penentu perilaku praktik imunisasi suntikan ganda di daerah pedesaan. Penelitian ini merupakan penelitian analitik dengan pendekatan kuantitatif dan cross-sectional. Populasinya adalah seluruh anak usia 9-12 bulan di Kabupaten Kendal dengan sampel sebanyak 407 anak. Responden adalah orang tua/pengasuh yang dipilih dari 30 Puskesmas. Pengumpulan data dilakukan dengan wawancara menggunakan kuesioner yang telah diuji validitas dan reliabilitasnya. Praktik imunisasi terlihat menggunakan Buku Kesehatan Ibu dan Anak. Praktik imunisasi dengan suntikan ganda sebagian berhubungan dengan pendidikan, pengetahuan, persepsi (kerentanan, keparahan, efek samping, manfaat), efikasi diri dan dukungan (keluarga, petugas kesehatan, komunitas, informasi dan kebijakan). Secara simultan diketahui bahwa dukungan petugas kesehatan mempunyai pengaruh yang paling dominan, diikuti oleh dukungan informasi, pengetahuan, persepsi keseriusan, dan persepsi kerentanan. Diperlukan upaya peningkatan kompetensi tenaga kesehatan dalam mengurangi kesakitan anak akibat vaksinasi, serta memberikan edukasi kepada orang tua/pengasuh secara efektif melalui komunikasi yang jelas sehingga mengurangi misinformasi dan mispersepsi terutama pada masyarakat pedesaan.

GRAPHICAL ABSTRACT



Keyword
immunization
perception
rural population
self efficacy
vaccination

*** Correspondence**
Faculty of Public Health, UNDIP Campus, Jl. Jacub Rais, Tembalang, Semarang City 50275, Indonesia
Email: ayunsriatmi@gmail.com

ISSN-P : 2086-2040
ISSN-E : 2548-5334

INTRODUCTION

Every child deserves immunization as the best strategy for preventing dangerous infectious diseases that potentially increase morbidity and mortality (Agrawal et al., 2020). Immunization is a very cost-effective prevention strategy (Ghosh et al., 2022) because it is relatively easy and has also succeeded globally in reducing the deaths of millions of children due to infectious diseases (Alghofaili et al., 2023; Chu & Rammohan, 2022), especially in developing countries. According to WHO, child vaccination coverage in developing countries is still low and cases of diseases that can be prevented through immunization are still the main cause of death for children under five years old (Ijarotimi et al., 2018). Globally, around 60% of 19.5 million babies do not have access to routine immunization services, and they live in sub-Saharan African countries, Angola, Brazil, Congo, Ethiopia, India, Indonesia, Iraq, Nigeria, Pakistan , South Africa (World Health Organization, 2023). Currently, some dangerous infectious diseases have been eliminated as a result of successful immunization, such as smallpox, polio, and tetanus. Immunization not only contributes to the eradication of diseases that can be prevented by immunization, but also has a positive impact on the health status of the community more broadly (Chu & Rammohan, 2022).

To elicit active immunity for children through antibody formation, immunization also provides advantages in preventing adverse events. A study in Nantes France showed that children who were not immunized with DPT/HB/HiB, IPV and PCV were correlated with an increased risk of Sudden Unexpected Death in Infancy (SUDI) (Deschanvres et al., 2023) or Sudden Infant Death Syndrome (SIDS) (Subramonian & Featherstone, 2020). Although there is no causal relationship between immunization and SIDS, it suggests that vaccination may have a protective effect against SIDS (Moon et al., 2022). Vaccination does not affect the incidence of SIDS and thus SIDS is not caused by vaccines. Although cases of SIDS in vaccinated children are much lower, vaccination coverage for routinely used childhood vaccines is not associated with an increased risk of SIDS (Yang & Shaw, 2018).

Despite the proven effectiveness of vaccines, not all children are getting the vaccines they need for various reasons (Bausad & Muchlisa, 2022). Globally, there are estimates of 67 million children who did not receive routine vaccinations fully or only partially from 2019-2021, with the East Asia and Pacific region alone accounting for 8.3 million children, including Indonesia (UNICEF, 2023). Some of the influencing factors include low trust in vaccines which leads to resistance, hesitation, delay and even refusal (Nair et al., 2021), as well as rumors and controversies related to vaccine safety (Destefano et al., 2019). Increased vaccine hesitancy is not only detrimental to individuals, but also to society as it has the potential to cause disease outbreaks (Agrawal et al., 2020). WHO also explicitly stated that vaccine hesitancy is one of the future global health threats (Dubé et al., 2021; Ghosh et al., 2022).

Anxiety about vaccine side effects and the pain children feel when vaccinated make parents reluctant and hesitant to vaccinate their children (Facciola et al., 2019; Viggiano et al., 2021), resulting in incomplete immunization status. Parents' knowledge and perceptions correlate with immunization completeness (Sriatmi et al., 2021). Lack of time, low awareness, fear of side effects, and loss of daily income opportunities are the main reasons why children are not immunized, in addition to barriers caused by healthcare workers' behavior (Singh et al., 2019). A study in India showed that incomplete immunization is due to fear of adverse side effects and the perception that new vaccines are riskier than old vaccines, leading to hesitancy among parents and caregivers (Ghosh et al., 2022). Parents are generally very concerned about the pain their child will experience, potential side effects, and uncertainty about vaccine effectiveness (Giannakou et al., 2021). Vaccine hesitancy is an emerging risk factor for

vaccine incompleteness (Ghosh et al., 2022).

In addition to incomplete vaccines received, other obstacles often associated with immunization are untimeliness (Ateudjieu et al., 2020; Bausad & Muchlisa, 2022; Dirirsa et al., 2022; Oktadevi et al., 2022), and high dropout cases (Ateudjieu et al., 2020; Ghosh & Laxminarayan, 2017). Timeliness of vaccination is an indicator of immunization program monitoring because it can assess the interval between the age recommended and the age when the vaccine dose is given, so that the potential for vaccine protection can be estimated (Kiely et al., 2018). The efficacy of vaccination against harmful infectious diseases depends not only on the type of vaccine, but also on the timeliness of its administration (Chu & Rammohan, 2022).

The coverage of national basic immunization tends to decline. Data from the Ministry of Health show that the achievement of complete basic immunization is 83.3% (in 2020) and 84.2% (in 2021), so it has not reached the national target of 93.6%. The Basic Health Research 2018 showed 57.9% of children with complete immunization status, 32.9% incomplete and 9.2% were not immunized at all (Ministry of Health RI, 2019). According to the national immunization program, since 2022 every child aged <12 months will receive a total of 15 doses of vaccine given in stages according to their age. Every child receives 11 doses of immunization sequentially until 9 months of age including: HB-0, BCG, Polio-OPV (4x), DPT/HB/HiB (3x), IPV and Measles-Rubella (MR). Since 2022, the government has added 2 new types of PCV and Rotavirus vaccines, each for 3 doses up to 12 months of age. All vaccines are given in injection form, except for Polio-OPV and Rotavirus vaccines which are given orally (drops). Because more types of antigens are given in the same age range, it is possible for each child to receive several vaccine injections in one immunization visit. The age range that has the potential to receive multiple injection immunization is two months of age (DPT/HB/HiB-1 and PCV-1), three months of age (DPT/HB/HiB-2 and PCV-2), four months of age (DPT/HB/HiB-3 and IPV), and nine months of age (MR and PCV-3). Although some countries have vaccination with multiple injections , making it safe (Dolan et al., 2017; World Health Organization, 2021), this model is not commonly understood and accepted by the community in Indonesia.

Conceptually, it can be understood that the vaccines given in the immunization program are partial, meaning that one type of vaccine is only for one type of disease, so several types of vaccines are needed for the prevention of different infectious diseases. Consequently, each child will get several types of vaccines within a certain period of time according to their age, both oral and injectable vaccines. For now, the administration of several types of vaccines in one visit is still controversial. Although clinically considered safe, it is considered to burden the immune system and make children vulnerable to health and growth disorders (Destefano et al., 2019), including when children are given multiple injections. The WHO further states that multiple injections in immunization are better because in addition to protecting children, they also increase efficiency by reducing the overall number of vaccination visits (World Health Organization, 2021).

The administration of multiple injection immunization is still controversial in Indonesia because it is not commonplace and often raises concerns among parents. Some of the raised concerns about multiple immunization are about receiving multiple injections, the location of the injection site, and its safety (Dolan et al., 2017). Although multiple injections are considered safe and efficient (World Health Organization, 2021), not all parents believe and comply with these provisions. A study in Saudi Arabia showed that the parent's parents' belief of that multiple vaccination is harmful to children was positively correlated with delayed immunization (Alghofaili et al., 2023). On the other hand, stress associated with

infant pain as routine procedures' result a result of routine procedures of vaccination has been found to affect postnatal growth and development, as it is associated with physiological and neurodevelopmental effects (Kassab et al., 2018). These reasons have resulted in many parents delaying and even refusing to give immunizations with multiple injections for their children, which has an impact on low immunization coverage. The aim of this study is to analyze the influence of behavioral factors on the practices of multiple injection immunization for children aged 9-12 months.

METHODS

This is a cross-sectional study with a quantitative approach. The study was conducted in rural areas focused on Kendal District, which is a district where childhood basic immunization coverage has tended to decline in the last 5 years and is included in the 10 districts in Central Java Province that have not yet reached the Universal Child Immunization (UCI) target. The study population was all children aged 9-12 months , totaling 10,096 children. Using the formula for minimal sample size from Lemeshow with a confidence level of 5%, the total sample of 407 children was obtained. Determination of the number of samples for 30 Primary Health Centers (PHCs) using proportional techniques resulted in approximately 6-23 children per PHC. Respondents per PHC were taken accidentally. Respondents were mothers or caregivers who live in the respective PHC area.

The independent variables are all variables that according to the Health Belief Model (HBM) concept contribute to individual behavior, including individual perception factors and modifying factors, namely sociodemographic characteristics, perceptions of perceived threats and expectations (benefits, obstacles, and self-efficacy), as well as support factors in the dimension of cues to action. The dependent variable is the mother's practice of immunization with multiple injections to her child according to the schedule, age, and type of vaccine. Primary data was obtained through interviews using instruments in the form of questionnaires which had previously been tested for validity and reliability, while secondary data was used to look at immunization practices using the Maternal and Child Health Book (MCH-Book). Data collection was carried out by researchers and assisted by enumerators who had previously been trained and given explanations regarding the questionnaire completion techniques through interviews that had to be carried out.

The collected data were analyzed using univariate, bivariate, and multivariate methods. Univariate analysis used frequency distribution, and bivariate analysis used the Chi-Square test because the data are categorical. Determination of the category of each variable used the median value because the normality test results showed that the data were not normally distributed. Multivariate tests were conducted using multiple logistic regression tests. Variables that can be included in multivariate modeling are variables that have a p-value <0.25 from the bivariate results. With the enter method, the data were analyzed in stages so that modeling could be obtained, where the variables in the modeling have a p-value <0.05. The overall effect was assessed using the R2 value with the determination of predictor variables based on the Exp(B) value obtained from the test. Through the multivariate test, it was also known which variable had the dominant influence. This study was approved by the Health Research Ethics Commission of the Public Health Faculty under certificate Number 364/EA/KEPK-FKM/2022.

RESULTS

Table 1 illustrates that almost half of the total 407 children aged 9-12 months, specifically 195 children (47.9%), did not receive multiple injections when receiving immunization services. In terms of characteristics, it was known that the largest proportion of respondents were adults with lower-middle education (elementary and junior high school) and do not work formally (being housewives). The number

Table 1
The Distribution of Variables Independents and Practices of Immunization with Multiple Injection

Independent Variables	Multiple Injection Practices		Total	Sig.
	No n (%)	Yes n (%)	n (%)	
Mother's age				
Young adults	102 (51.0)	98 (49.0)	200 (49.1)	0.26
Adults	93 (44.9)	114 (55.1)	207 (50.9)	
Education				
Middle to lower	138 (56.6)	106 (43.4)	244 (60.0)	0.000*
Middle to upper	57 (35.0)	106 (65.0)	163 (40.0)	
Occupational				
Not working (housewife)	128 (49.8)	129 (50.2)	257 (63.1)	0.369
Working formally	67 (44.7)	83 (55.3)	150 (36.9)	
Number of children				
Many (>2 people)	43 (44.3)	54 (55.7)	97 (23.8)	0.489
Few (1-2 people)	152 (49.0)	158 (51.0)	310 (76.2)	
Income per month				
Low (<Rp 2,000,000)	33 (52.4)	30 (47.6)	63 (15.5)	0.525
High (≥Rp 2,000,000)	162 (47.1)	182 (52.9)	344 (84.5)	
Having health insurance (BPJS)				
No	44 (47.3)	49 (52.7)	93 (22.9)	0.989
Yes (BPJS)	151 (48.1)	163 (51.9)	314 (77.1)	
Access to PHC				
Difficult	107 (46.1)	125 (53.9)	232 (57.0)	0.464
Easy	88 (50.3)	87 (49.7)	175 (43.0)	
Knowledge				
Less	94 (87.0)	14 (13.0)	108 (26.5)	0.000*
Good	101 (33.8)	198 (66.2)	299 (73.5)	
Perceived susceptibility				
High	75 (91.5)	7 (8.5)	82 (20.1)	0.000*
Low	120 (36.9)	205 (63.1)	325 (79.9)	
Perceived severity				
High	89 (88.1)	12 (11.9)	101 (24.8)	0.000*
Low	106 (34.6)	200 (65.4)	306 (75.2)	
Perception of benefit				
Low	116 (71.2)	47 (28.8)	163 (40.0)	0.000*
High	79 (32.4)	165 (67.6)	244 (60.0)	
Perception of barriers				
Many	46 (50,0)	46 (50.0)	92 (22.6)	0.736
Few	149 (47,3)	166 (52.7)	315 (77.4)	
Perception of adverse events				
Severe	91 (70,5)	38 (29.5)	129 (31.7)	0.000*
Mild	104 (37,4)	174 (62.6)	278 (68.3)	
Self-efficacy				
Low	59 (75,6)	19 (24.4)	78 (19.2)	0.000*
High	136 (41,3)	193 (58.7)	329 (80.8)	
Family supports				
Low	108 (76,1)	34 (23.9)	142 (34.9)	0.000*
High	87 (32,8)	178 (67.2)	265 (65.1)	
Community supports				
Low	139 (76,8)	42 (23.2)	181 (44.5)	0.000*
High	56 (24,8)	170 (75.2)	226 (55.5)	
Health workers supports				
Low	81 (94,2)	5 (5.8)	86 (21.1)	0.000*
High	114 (35,5)	207 (64.5)	321 (78.9)	
Informational/media supports				
Low	50 (96,2)	2 (3.8)	52 (12.8)	0.000*
High	145 (40,8)	210 (59.2)	355 (87.2)	
Policy supports				
Low	100 (60,6)	65 (39.4)	165 (40.5)	0.000*
High	95 (39,3)	147 (60.7)	242 (59.5)	

Note: * Significant for p<0.05

Table 2
Result of Multivariate Analysis

Variables	β	SE	df	Sig.	Exp.β	95% CI for Exp.β	
						Lower	Upper
Knowledge	1.833	0.405	1	0	6.255	2.827	13.842
Perceived susceptibility	1.653	0.517	1	0.001	5.22	1.895	14.381
Perceived severity	1.698	0.421	1	0	5.461	2.395	12.454
Perception of benefits	0.96	0.326	1	0.003	2.612	1.378	4.952
Perception of adverse events	0.76	0.347	1	0.029	2.138	1.083	4.22
Family supports	0.702	0.359	1	0.051	2.017	0.997	4.08
Community supports	0.966	0.334	1	0.004	2.628	1.366	5.058
Health workers supports	2.277	0.556	1	0	9.749	3.281	28.972
Informational supports	2.003	0.875	1	0.022	7.414	1.334	41.216
Constant	-10.031	1.226	1	0	0	-	-

Note: Significant for p<0,05; Value of Nagelkerke R Square (R2) = 0,696

of children they had was 1-2, with average monthly income being high by district standards (≥ IDR 2,000,000) and most had health insurance (BPJS). However, more than half of respondents (57%) stated that access to PHC was quite difficult due to long distances and limited transportation.

Descriptively, it was known that in the group of children who did not get multiple injection immunization, the proportion was greater than those whose mother's age was younger, with lower-middle education, not working, low income, lack of knowledge, low perception of benefits, perception of adverse events and self-confidence , and low support (family, community, officer, information, and policy) (see Table 1). The results proved that variables are statistically associated with multiple injection immunization practices (p-value <0.05), namely education, knowledge, perceived susceptibility, perceived severity, perceived benefits, perceived adverse events, self-efficacy, family support, community support, health workers' support, information support, and policy support. There was a significant relationship between these variables individually with the practice of immunization with multiple injections. However, the variables age, occupation, number of children, income, ownership of health insurance (BPJS), access to PHC, and perceived barriers were not statistically associated with the practice of multiple injection immunization (p-value > 0.05).

Table 2 shows the multivariate test results to determine the variables that have a dominant influence on the practice of multiple injection immunization. It proved that variables of knowledge, perceived susceptibility, perceived severity, perception of benefits, perception of adverse events, family support, community support, health workers' support, and informational support simultaneously influenced the practice of multiple injection immunization with an overall effect of 69.6% (R2 value = 0.696). These variables are predictors of multiple injection immunization practices because the Exp(B) value obtained was greater than 2 (>2.00). In order, the most dominant variable influencing this practice was the health workers' support with an Exp(B) of 9.749, followed by informational support (Exp(B) 7.414), knowledge (Exp (B) 6.255), perceived severity (Exp(B) 5.461), and perceived susceptibility (Exp(B) 5.220). Meanwhile, the variables of community support, perception of benefits, perception of adverse events and family support also contributed to the practice of multiple injection immunization with Exp(B) values ranging from 2.628-

2.017. These results prove that high support , followed by good knowledge and positive perceptions influence good practices in multiple injection immunization.

DISCUSSION

The results of the study proved that factors of individual perception contribute greatly to the behavior of multiple injection immunization practices, including perceived vulnerability, perceived severity, perceived benefits, and perceived adverse events, in addition to the support factors received (from family, community and health workers). Correct and adequate information support also contributes to parents' positive behavior in carrying out multiple immunization through increasing their knowledge. The results of bivariate and multivariate tests show a significant relationship. Theoretically, it can be understood that if parents have the perception that multiple injection immunization is safe, useful and has few side effects, they will not feel worried or anxious about immunizing their children. This is especially true if they receive the correct and clear information regarding all matters related to immunization.

One of the parents' reasons for reluctance to vaccinate is fear and anxiety about the pain that children will experience during injectable vaccinations (Althumairi et al., 2021; Kassab et al., 2018; Viggiano et al., 2021). Vaccination is a painful procedure that causes pain, makes children cry and feel uncomfortable, and is a significant source of iatrogenic pain (Abukhaled & Cortez, 2021). There is a perception that the more vaccine injections are given, the longer the pain. Multiple vaccinations are also unsafe and contraindicated (Albers et al., 2022; Alghofaili et al., 2023). To reduce these conditions, support from all parties is needed, especially from parents/ caregivers, family, and health workers. Parental concerns about multiple injections can be addressed through reassurance, clear communication, and pain reduction techniques (World Health Organization, 2021).

Several pain reduction techniques can be provided to children during vaccination. Providing external cooling and vibration at the injection site has been shown to reduce children's pain and anxiety levels during vaccination (Sapçi et al., 2021). The analgesic effect of breastfeeding has been shown to reduce pain in children, and the strategy of embracing children can increase comfort while helping to reassure mothers during the vaccination process (Viggiano et al., 2021). Through nonpharmacological methods, namely by breastfeeding to infants or giving 24% sucrose solution (SS) of 2 mL to children orally followed by non-nutritive sucking based on parental availability and preference for 2 minutes before vaccine injection was given, it is proven to reduce pain and parental anxiety during vaccination (Abukhaled & Cortez, 2021). The presence of parents in the immunization room also significantly reduced the duration of crying time (Kassab et al., 2018). Through the use of Virtual Reality applications which are technology-based distraction innovations, it has been proven to have a positive impact on reducing pain and fear in children aged 4-6 years during vaccination in Saudi Arabia (Althumairi et al., 2021). Therefore, it is necessary for health workers to have the ability to give injections with a low risk of pain through various training or practice trials to improve these skills, as well as techniques to reduce the pain level that may arise as a result of the injections given.

Rejection of multiple injection immunization begins with misinformation and misperceptions that arise from information gaps received by parents/caregivers. This result is in line with Kagone et al.'s study in Burkina Faso that information gaps in the community, poor interaction between parents and health workers, and difficult geographical access are associated with low utilization of immunization services (Kagoné et al., 2018). Misinformation can be caused by incomplete, inaccurate, and incorrect information about vaccination. It can also be

caused by inappropriate communication methods or miscommunication resulting in misunderstandings. These conditions have the potential to increase distrust of vaccines and the potential for increasingly severe risks (Garcia et al., 2023). Information literacy is the key to overcoming these obstacles. A study in Malaysia showed that misconceptions and concerns about vaccine side effects, and preference for alternative medicine are contributing factors to increased vaccine hesitancy, in addition to low knowledge and awareness among parents (Panting et al., 2018). Lack of awareness and limited access to vaccination services are often reported by parents who are hesitant about vaccination are often reported by parents who are hesitant towards vaccination (Agrawal et al., 2020).

Parents' knowledge and positive perceptions are key to successful immunization. In the behavior concept, knowledge, attitudes, and perceptions are predisposing factors that shape a person's practice or action. Knowledge is formed from education and experience, which in turn shapes perceptions, attitudes, and intentions. Knowledge is the dominant variable influencing immunization practices, including multiple injection vaccination, eliminating doubts and anxiety, and minimizing rejection. These results are in line with various other studies. There is a strong correlation between maternal knowledge and attitude towards the completeness of basic immunization (Sriatmi et al., 2021). Integrated knowledge negatively affects parental anxiety related to vaccination and positively affects rational decision making (Wang et al., 2020). On the other hand, inefficient dissemination of information about diseases and related vaccines and lack of monitoring of misinformation lead to negative perceptions and attitudes while increasing hesitancy or rejection of vaccines (Hasnan & Tan, 2021).

Education is one of the formal elements that form knowledge. The higher the education, the better the knowledge. Strategies to improve knowledge about immunization can be done formally at school or informally in the family and community environment with a routine communication, information, and education (IEC) model. Research results prove that parental education and utilization of health services are strong predictors of immunization completeness and age accuracy in vaccination in Indonesia (Chu & Rammohan, 2022). Maternal education and wealth index were confounding factors in influencing immunization completeness in India (Kanchan et al., 2018). A study in Hong Kong also proves that predictors of incomplete immunization are maternal education, socioeconomic status, gender, and place of deliveries (Ghosh et al., 2022). Maternal education is a significant factor associated with immunization timeliness, while low knowledge and socioeconomic resources are the main barriers to incomplete basic immunization for children (Nalley & Maduka, 2019; Siramaneerat & Agushybana, 2021).

Another variable that influences knowledge is experience. Parents who have previous negative experiences regarding child vaccinations tend to refuse further immunizations that should be received (Agrawal et al., 2020). Emotional distress, past negative experiences, and misunderstandings contribute to vaccine hesitancy in children and families (Hasnan & Tan, 2021). It was further explained by Garcia et al. that reactions to previous adverse experiences were associated with distrust of vaccines and a perception of greater risk which ultimately resulted in a deliberate delay in not vaccinating children (Garcia et al., 2023). Efforts to overcome obstacles caused by bad experiences regarding vaccination include strengthening literacy, education, communication and improving the immunization service system, especially in cold chain management, side effect risk management, reporting and recording systems, and responsiveness to various complaints about the implementation of immunization.

Perception has a dominant influence in the practice of multiple injection immunization, including perceptions of susceptibility, percep-

tions of severity, perceptions of benefits and perceptions of possible side effects. Garcia et al.'s study in Brazil showed that an important component that determines the scale of doubt is low confidence in vaccines and the perception of risk from the vaccine given (Garcia et al., 2023). Parents/caregivers who perceive that their children are susceptible to disease and will get worse if they do not receive complete immunization, who consider immunization to be very useful and correctly understand the risks of side effects and efforts to overcome them have a greater chance of receiving multiple injection immunization services. Compliance behavior towards immunization tends to depend on what is known, who is known and what the environment (where people live) is like (Agrawal et al., 2020). A well-organized immunization program is a key factor in improving children's health through meeting clear needs and community perceptions of program performance (Kagoné et al., 2018).

The availability of accurate and clear information correlates with vaccination utilization, while reducing anxiety, doubt and resistance to vaccination. Valid information about vaccine safety, benefits and post-vaccination management improves attitudes, perceptions and beliefs of parents and caregivers. Refusal to receive multiple injections results from fear of increasing pain and feelings of insecurity due to the consequences of increasing the number of injections (Dolan et al., 2017). Various controversies and rumors surrounding vaccines have had a major impact on low acceptance and negative perceptions about the risks and benefits of vaccination (Agrawal et al., 2020; Destefano et al., 2019). It must be acknowledged that the spread of rumors and misinformation about vaccination is mainly through social media and other technology-based means of communication. According to Dube et al.'s study, the internet and social media are the most widely used media for communicating, learning, and making decisions about vaccination today, but many studies also show that delays and refusals to vaccinate are more often found in parents/caregivers who use the internet as the main source of information about vaccines (Dubé et al., 2021), including the mass media (Bianco et al., 2019).

Access to information about vaccines and immunization mainly comes from health workers and information media, including social media. The health workers' ability to provide required information through good interpersonal communication is one form of positive support that increases immunization use. Effective interaction between health workers and parents regarding immunization is an important but challenging element to maintaining public trust in vaccination, especially when counseling time is very limited (Wang et al., 2020). A systematic review study in rural USA shows that health workers are the dominant source of information in the success of immunization programs (Albers et al., 2022). Dolan et al. further explained in their study that positive recommendations from health workers and high concern about the severity of the disease if not immunized increased acceptance of all injections given, including multiple injections (Dolan et al., 2017). Support from service providers and health workers is an important component of increasing public trust in scientific and epidemiological evidence about vaccination (Bianco et al., 2019).

Psychologically, every person has a reactance dimension, namely the tendency to restore autonomy when they feel that someone else is trying to impose their will. Therefore, the approach to interaction and communication between health workers and parents/caregivers in delivering immunization messages must adapt to these psychological factors. Communication strategies that are universal are less appropriate to use and can have different reaction effects on each parent. Finkelstein et al.'s study on parents in the US proves that those who have high psychological reactance tend not to prioritize vaccination and this relationship is based on their evaluation of the quality of doc-

tor communication and their perception of vaccine safety (Finkelstein et al., 2020). Similar results were also found in Finland, where parents with high reactance had low trust in doctors, negative attitudes towards vaccines and refused them, and tended to choose alternative treatments to overcome the problem (Soveri et al., 2020). The massive negative influence of the anti-vaccine movement through the media is also one of the factors increasing vaccine resistance in society (Dubé et al., 2021). This study indicates successful practice of multiple injection immunization must focus on improving parents' perceptions which so far tend to be negative and incorrect. Efforts to improve perceptions must be supported by all parties, especially health workers who have been the main source of information about immunization in rural areas.

CONCLUSIONS

Parents, caregivers, and the community tend not to understand multiple injections for immunization. Almost half (47.9%) of children did not receive the multiple injection in the immunization service they received and it tended to be delayed by several days. The influencing factors are knowledge, perception and support provided including family support, health workers, community, and informational support. Support from health workers is the most dominant influence, followed by informational support, knowledge, perceived severity and perceived susceptibility. The higher the support, maternal knowledge, and positive perception about immunization, the greater the willingness of parents to immunize their children, including receiving multiple injections. Efforts are needed to increase health workers' competency in reducing pain in children due to vaccination through continuous training and skills practice, as well as providing education to parents and caregivers effectively through clear communication to reduce misinformation and misperceptions. Rumors and misunderstandings about vaccines and vaccination increase anxiety and hesitancy, ultimately resulting in delays and refusal of immunization. Special policies are needed from local government in the form of regulations that technically regulate the routine immunization services mechanism that have the potential for multiple injections, as well as monitoring and evaluating immunization services that have the potential to create negative perceptions in the community, especially regarding adverse events and vaccine safety. Further studies using exploratory techniques to understand public perceptions of immunization also need to be carried out.

ACKNOWLEDGEMENT

We would like to thank the Kendal District Health Office for granting permission for the study location and permission to collecting the necessary data, as well as thank to as well as thank all the enumerators and data collection teams involved in it.

FUNDING

This article was financially supported by Universitas Diponegoro and the Health Promotion Master Program for financial support in publishing this study result.

AUTHORS' CONTRIBUTIONS

Ayun Sriatmi wrote the manuscript, analyzed the data, and revised the manuscript. Setyo E. Pratiwi enrolled participants, collected and analyzed the data. Farid Agushybana collected and analyzed the data. All authors designed the study, formulated the concept, reviewed and approved the final manuscript.

AUTHORS' INFORMATION

Dr. Dra. Ayun Sriatmi, MKes is an Associate Professor of Health Policy and Administration Department, Faculty of Public Health, Universitas Diponegoro, Semarang, Indonesia. Setyo Endah Pratiwi, SKM, MKes is an alumnus of Health Promotion Master's Program of Universitas Diponegoro and she is currently as the person in charge of the surveillance and immunization program at Kendal's District Health Office, Central Java. Farid Agushybana, SKM, DEA, PhD is an Assisten Professor of Biostatistic and Demography Department, Faculty of Public Health, Universitas Diponegoro, Semarang, Indonesia

COMPETING INTERESTS

The authors confirm that all of the text, figures, and tables in the submitted manuscript work are original work created by the authors and that there are no competing professional, financial, or personal interests from other parties.

REFERENCES

Abukhaled, M., & Cortez, S. (2021). Nonpharmacological Methods for Reducing Parental Concern for Infant Vaccine-Associated Pain. *Journal of Pediatric Health Care*, *35*(2), 180–187. https://doi.org/10.1016/j.pedhc.2020.09.006

Agrawal, A., Kolhapure, S., Di Pasquale, A., Rai, J., & Mathur, A. (2020). Vaccine Hesitancy as a Challenge or Vaccine Confidence as an Opportunity for Childhood Immunisation in India. *Infectious Diseases and Therapy*, *9*(3), 421–432. https://doi.org/10.1007/s40121-020-00302-9

Albers, A. N., Thaker, J., & Newcomer, S. R. (2022). Barriers to and facilitators of early childhood immunization in rural areas of the United States: A systematic review of the literature. *Preventive Medicine Reports*, *27*(April), 101804. https://doi.org/10.1016/j.pmedr.2022.101804

Alghofaili, M. A., Aljuaid, S. O., Alqahtani, N., Alghufaili, M., & Abd-Ellatif, E. E. (2023). Factors Contributing to the Delayed Vaccination Among Children in Riyadh City, Saudi Arabia: A Cross-Sectional Study. *Cureus*, *15* (Mcv), 1–14. https://doi.org/10.7759/cureus.43188

Althumairi, A., Sahwan, M., Alsaleh, S., Abduljabbar, Z., & Aljabri, D. (2021). Virtual reality: Is it helping children cope with fear and pain during vaccination? *Journal of Multidisciplinary Healthcare*, *14*, 2625–2632. https://doi.org/10.2147/JMDH.S327349

Ateudjieu, J., Yakum, M. N., Goura, A. P., Tembei, A. M., Ingrid, D. K., Bita'A Landry, B., Kenfack, B., Amada, L., Tadzong, I., & Bissek, A. C. (2020). EPI immunization coverage, timeliness and dropout rate among children in a West Cameroon health district: A cross sectional study. *BMC Public Health*, *20*(1), 1–11. https://doi.org/10.1186/s12889-020-8340-6

Bausad, A. A. P., & Muchlisa, N. (2022). Faktor yang Mempengaruhi Cakupan dan Ketepatan Waktu Imunisasi. *Jurnal Kesehatan Ilmiah Indonesia*, *7*(2), 161–166. https://jurnal.unar.ac.id/index.php/health/article/view/915/565

Bianco, A., Mascaro, V., Zucco, R., & Pavia, M. (2019). Parent perspectives on childhood vaccination: How to deal with vaccine hesitancy and refusal? *Vaccine*, *37*(7), 984–990. https://doi.org/10.1016/j.vaccine.2018.12.062

Chu, H., & Rammohan, A. (2022). Childhood immunization and age-appropriate vaccinations in Indonesia. *BMC Public Health*, *22*(1), 1–12. https://doi.org/10.1186/s12889-022-14408-x

Deschanvres, C., Levieux, K., Launay, E., Huby, A. C., Scherdel, P., de Visme, S., Hanf, M., & Gras-Le Guen, C. (2023). Non-immunization associated with increased risk of sudden unexpected death in infancy: A national case–control study. *Vaccine*, *41*(2), 391–396. https://doi.org/10.1016/j.vaccine.2022.10.087

Destefano, F., Bodenstab, H. M., & Offit, P. A. (2019). Principal Controversies in Vaccine Safety in the United States. *Clinical Infectious Diseases*, *69*(4), 726–731. https://doi.org/10.1093/cid/ciz135

Dirirsa, K., Makuria, M., Mulu, E., & Deriba, B. S. (2022). Assessment of vaccination timeliness and associated factors among children in Toke Kutaye district, central Ethiopia: A Mixed study. *PLoS ONE*, *17*(1 January), 1–17. https://doi.org/10.1371/journal.pone.0262320

Dolan, S. B., Patel, M., Hampton, L. M., Burnett, E., Ehlman, D. C., Garon, J., Cloessner, E., Chmielewski, E., Hyde, T. B., Mantel, C., & Wallace, A. S. (2017). Administering Multiple Injectable Vaccines during a Single Visit - Summary of Findings from the Accelerated Introduction of Inactivated Polio Vaccine Globally. *Journal of Infectious Diseases*, *216*(April (Suppl 1)), S152–S160. https://doi.org/10.1093/infdis/jix054

Dubé, È., Ward, J. K., Verger, P., & MacDonald, N. E. (2021). Vaccine Hesitancy , Acceptance , and Anti-Vaccination : Trends and Future Prospects for Public Health. *Annual Review of Public Health*, *42*, 175–191. http://www.orspaca.org/sites/default/files/annurev-publhealth-vaccine-hesitancy.pdf

Facciola, A., Visalli, G., Orlando, A., Bertuccio, M. P., Spataro, P., Squeri, R., Picerno, I., & Di Pietro, A. (2019). Vaccine hesitancy: An overview on parents' opinions about vaccination and possible reasons of vaccine refusal. *Journal of Public Health Research*, *8*(1), 13–18. https://doi.org/10.4081/jphr.2019.1436

Finkelstein, S. R., Boland, W. A., Vallen, B., Connell, P. M., Sherman, G. D., & Feemster, K. A. (2020). Psychological reactance impacts ratings of pediatrician vaccine-related communication quality, perceived vaccine safety, and vaccination priority among U.S. parents. *Human Vaccines and Immunotherapeutics*, *16*(5), 1024–1029. https://doi.org/10.1080/21645515.2019.1694815

Garcia, É. M., Souza, E. L. de, Matozinhos, F. P., Silva, T. M. R. da, Waldman, E. A., & Sato, A. P. S. (2023). Associated factors with vaccine hesitancy in mothers of children up to two years old in a Brazilian city. *PLOS Global Public Health*, *3*(6), e0002026 (1-15). https://doi.org/10.1371/journal.pgph.0002026

Ghosh, A., Annigeri, S., Hemram, S. K., Dey, P. K., Mazumder, S., & Ghosh, P. (2022). Demography and determinants of incomplete immunization in children aged 1–5 years and vaccine-hesitancy among caregivers: An Eastern Indian perspective. *Clinical Epidemiology and Global Health*, *17*, 101155.. https://doi.org/10.1016/j.cegh.2022.101155

Ghosh, A., & Laxminarayan, R. (2017). Demand-and supply-side determinants of diphtheria-pertussis-tetanus nonvaccination and dropout in rural India. *Vaccine*, *35*(7), 1087-1093. https://doi.org/10.1016/j.vaccine.2016.12.024

Giannakou, K., Kyprianidou, M., Hadjikou, A., Fakonti, G., Photiou, G., Tzira, E., & Heraclides, A. (2021). Knowledge of mothers regarding children's vaccinations in Greece: an online cross-sectional study. *BMC Public Health*, *21*(1), 1–13. https://doi.org/10.1186/s12889-021-12179-5

Hasnan, S., & Tan, N. C. (2021). Multi-domain narrative review of vaccine hesitancy in childhood. *Vaccine*, *39*(14), 1910–1920. https://doi.org/10.1016/j.vaccine.2021.02.057

Ijarotimi, I. T., Fatiregun, A. A., Adebiyi, O. A., Ilesanmi, O. S., & Ajumobi, O. (2018). Urban–rural differences in immunisation status and associated demographic factors among children 12-59 months in a Southwestern state, Nigeria. *PLoS ONE*, *13*(11), 1–11. https://doi.org/10.1371/journal.pone.0206086

Kagoné, M., Yé, M., Nébié, E., Sié, A., Müller, O., & Beiersmann, C. (2018). Community perception regarding childhood vaccinations and its implications for effectiveness: a qualitative study in rural Burkina Faso. *BMC Public Health*, *18*(324), 1–10. https://doi.org/https://doi.org/10.1186/s12889-018-5244-9

Kanchan, M. I., Firoz, M., Kurlikar, P. R., Chourase, M., Yadav, R., & Biswas, A. B. (2018). Status and determinants of child immunisation coverage in three South Asian countries, India, Bangladesh and Nepal: Evidence from the Demographic and Health Survey. *Sri Lanka Journal of Child Health*, *47*(1), 56–63. https://doi.org/10.4038/sljch.v47i1.8431

Kassab, M., Hamadneh, S., Nuseir, K., ALmomani, B., & Hamadneh, J. (2018). Factors Associated With Infant Pain Severity Undergoing Immunization Injections. *Journal of Pediatric Nursing*, *42*, e85–e90. https://doi.org/10.1016/j.pedn.2018.04.002

Ministry of Health RI. (2019). Laporan Nasional Riskesdas 2018. In *Badan Penelitian dan Pengembangan, Kementerian Kesehatan RI* (Vol. 1, Issue 1). https://www.kemkes.go.id/article/view/19093000001/penyakit-jantung-penyebab-kematian-terbanyak-ke-2-di-indonesia.html

Kiely, M., Boulianne, N., Talbot, D., Ouakki, M., Guay, M., Landry, M., Sauvageau, C., & De Serres, G. (2018). Impact of vaccine delays at the 2, 4, 6 and 12 month visits on incomplete vaccination status by 24 months of age in Quebec, Canada. *BMC Public Health*, *18*(1), 1–15. https://doi.org/10.1186/s12889-018-6235-6

Moon, R. Y., Carlin, R. F., & Hand, I. (2022). Sleep-Related

Infants Deaths: Updated 2022 Recommendations for Reducing Infant Deaths in the Sleep Environment. Pediatrics, *150*(6), 1–22. https://doi.org/10.1542/peds.2022-059737Ahttps://doi.org/10.1542/peds.2022-057990

Nair, A. T., Nayar, K. R., Koya, S. F., Abraham, M., Lordson, J., Grace, C., Sreekumar, S., Chembon, P., Swarnam, K., Pillai, A. M., & Pandey, A. K. (2021). Social media, vaccine hesitancy and trust deficit in immunization programs: a qualitative enquiry in Malappuram District of Kerala, India. *Health Research Policy and Systems*, *19 (Supp 2*(56), 1–8. https://doi.org/10.1186/s12961-021-00698-x

Nalley, J., & Maduka, O. (2019). Completeness and timeliness of immunization among children aged 12 to 23 months in South-South Nigeria. *Journal of Community Medicine and Primary Health Care*, *31*(1), 22–31. https://doi.org/10.4314/JCMPHC.V31I1

Oktadevi, D., Sriatmi, A., & Kusumastuti, W. (2022). Karakteristik Ibu dalam Ketepatan Waktu Imunisasi Measles Rubella Selama Pandemi Covid-19 di Puskesmas Tempuran Kabupaten Magelang. *Media Kesehatan Masyarakat Indonesia*, *21*(3), 148–152. https://doi.org/10.14710/mkmi.21.3.148-152

Panting, A. J., Zin, Z. M., Jaafar, N., Perialathan, K., Ilman, S. S. S., & Zakaria, M. R. (2018). Potential Factors Contributing to Vaccine Hesitancy among Parents in Malaysia: An Overview. *International Journal of Health Sciences & Research (Www.Ijhsr.Org)*, *8*(7), 360. www.ijhsr.org

Sapçi, E., Bilsin Kocamaz, E., & Gungormus, Z. (2021). Effects of applying external cold and vibration to children during vaccination on pain, fear and anxiety. *Complementary Therapies in Medicine*, *58*(November 2020), 102688. https://doi.org/10.1016/j.ctim.2021.102688

Singh, S., Sahu, D., Agrawal, A., & Vashi, M. D. (2019). Barriers and opportunities for improving childhood immunization coverage in slums: A qualitative study. *Preventive Medicine Reports*, *14*(March), 100858. https://doi.org/10.1016/j.pmedr.2019.100858

Siramaneerat, I., & Agushybana, F. (2021). Inequalities in immunization coverage in Indonesia: a multilevel analysis. *Rural and Remote Health*, *21*(3), 1–11. https://doi.org/10.22605/rrh6348

Soveri, A., Karlsson, L. C., Mäki, O., Antfolk, J., Waris, O., Karlsson, H., Karlsson, L., Lindfelt, M., & Lewandowsky, S. (2020). Trait reactance and trust in doctors as predictors of vaccination behavior, vaccine attitudes, and use of complementary and alternative medicine in parents of young children. *PLoS ONE*, *15*(7 July), 1–16. https://doi.org/10.1371/journal.pone.0236527

Sriatmi, A., Martini, M., Agushybana, F., Jati, S. P., Astorina, N., Handayani, N., & Nandini, N. (2021). Complete Basic Immunization Coverage among Infants in Temanggung Regency. *Jurnal Aisyah: Jurnal Ilmu Kesehatan*, *6*(4), 645–650. https://doi.org/10.30604/jika.v6i4.815

Subramonian, A., & Featherstone, R. (2020). Interventions for the Prevention of Sudden Infant Death Syndrome and Sudden Unexplained Death in Infancy: a Review of Guidelines. *CADTH; Rapid Response Service*, *1*(September 14), 1–24. https://www.ncbi.nlm.nih.gov/books/NBK566620/

UNICEF. (2023). For Every Child: Vaccination (Regional Brief). In *East Asia and The Pacific-The State of The World's Children 2023* (pp. 0–23). https://www.unicef.org/media/138981/file/Estado%20Mundial%20de%20la%20Infancia%202023.pdf

Viggiano, C., Occhinegro, A., Siano, M. A., Mandato, C., Adinolfi, M., Nardacci, A., Caiazzo, A. L., Viggiano, D., & Vajro, P. (2021). Analgesic effects of breast- and formula feeding during routine childhood immunizations up to 1 year of age. *Pediatric Research*, *89*(5), 1179–1184. https://doi.org/10.1038/s41390-020-0939-x

Wang, P., Fan, W., & Li, Q. (2020). The alleviation effect of knowledge integration on anxiety in parental vaccine decision-making supported by online communities. *Journal of Knowledge Management*, *25*(6), 1575–1593. https://doi.org/10.1108/JKM-05-2020-0329

World Health Organization. (2021). Module 8: Safety and acceptability of multiple injections. In *Training for Inactivated Poliovirus Vaccine (IPV) Introduction* (pp. 1–20). https://cdn.who.int/media/docs/default-source/immunization/multiple-injections/training_mod8_multiple_injections-june2016.pdf

World Health Organization. (2023). *Immunization Coverage: Fact Sheet*. World Health Organization. https://www.who.int/news-room/fact-sheets/detail/immunization-coverage

Yang, Y. T., & Shaw, J. (2018). Sudden infant death syndrome, attention-deficit/hyperactivity disorder and vaccines: Longitudinal population analyses. *Vaccine*, *36*(5), 595–598. https://doi.org/10.1016/j.vaccine.2017.12.065