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Child, Parental, and Household Factors on Inactivated Poliovirus Vaccine Use

Ayun Sriatmi[1]✉, Martini[2], Sutopo Patria Jati[1], Budiyono[3], Novia Handayani[4], Aditya Kusumawati[4], Tutut Okta Hardiyanti[5]

[1]Department of Health Policy and Administration, Faculty of Public Health, Universitas Diponegoro, Semarang
[2]Department of Epidemiology and Tropical Disease, Faculty of Public Health, Universitas Diponegoro, Semarang
[3]Department of Environmental Health, Faculty of Public Health, Universitas Diponegoro, Semarang
[4]Department of Health Promotion, Faculty of Public Health, Universitas Diponegoro, Semarang
[5]Health Research Center, Institute for Research and Community Service, Universitas Diponegoro, Semarang

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Abstract

Although the immunization program requires OPV vaccine for every infant, outbreaks of polio and Acute Flaccid Paralysis (AFP) still occur frequently, triggering a rapid response of mass immunization. The vaccine of Inactivated Polio Virus (IPV) was added to prevent wild poliovirus, which causes paralysis, but its effectiveness has not been optimal. The purpose of the study was to analyse the effect of child characteristics, perceptions, parental hygiene practices, and the house's physical conditions on the IPV vaccination utilization. This study was a quantitative survey with a cross-sectional approach. The population was all children aged <7 years in Central Java Province. A sample of 1,069 children was obtained through convenience sampling from 15 districts/cities serving as RCA locus for 2024 Polio SubPIN activities. Data collection was conducted through observations using the KIA Handbook, home visits, and interviews using a questionnaire. Data was analysed using descriptive, bivariate, and multivariate statistics. The results showed that 85.9% of children utilized 4-doses OPV vaccination completely, and 83.6% utilized the first dose of IPV vaccination. It was proven that OPV immunization status, parental hygiene practices, and the house's physical condition were associated with IPV vaccine utilization, both partially and simultaneously. The effect of three variables was 27%, with OPV immunization status being the main predictor. There was a 3.54-fold increase in IPV utilization if OPV status was complete, followed by parental hygiene (OR=2.02) and the house's physical condition (OR=1.56). More intensive socialization regarding IPV vaccination is needed through personal communication interventions that can also motivate parents. Strengthening the vaccination service system by providing vaccine stocks and cold chains as needed, regulatory support, and effective IEC are key factors in the success of IPV vaccination.

Introduction

Polio is caused by the poliovirus, which causes poliomyelitis. Poliovirus infection attacks the nervous system and causes a variety of clinical manifestations, from nonspecific fever to aseptic meningitis, paralysis, and death (Tamir *et al*., 2024; Tarawally *et al*., 2024). Polio can damage motor neurons, causing lifelong muscle dysfunction or even death, especially if it affects respiratory function (Kusumaratna *et al*., 2024; Sriatmi, Martini, Patriajati, Budiyono, *et al*., 2024). Polio is transmitted through the

✉ Correspondence Address:
Department of Health Policy and Administration, Faculty of Public Health, Universitas Diponegoro, Semarang
Email: ayunsriatmi@gmail.com

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oral-oral or fecal-oral route, originating from the environment or water contaminated with the poliovirus (Estivariz *et al*., 2023). The poliovirus that enters the body replicates in the intestines and is excreted through feces into the environment, so a dirty environment has the potential to spread poliovirus. The virus that enters the body will develop in the digestive tract, then attack nerve cells in the muscles. Serology is used to diagnose poliomyelitis, and there is no specific treatment for poliovirus (Tamir *et al*., 2024). Poliomyelitis is an acute, largely contagious, neurotropic viral disease caused by serotypes 1, 2, and 3 of the wild polioviruses (Tamir *et al*., 2024).

Polio can be prevented through polio vaccination. There are two types of polio vaccine: the Sabin type, which contains live weakened poliovirus and is administered orally (Oral Polio Vaccine or OPV), and the Salk type, which contains inactivated polio vaccine and is administered as an injection (Inactivated Polio Vaccine or IPV). The universal vaccination of infants and children is the only way to build and maintain population immunity against poliovirus to prevent poliomyelitis (Tamir *et al*., 2024). The OPV vaccine provides immune protection primarily in the gastrointestinal tract, while the IPV vaccine protects the bloodstream. Although very rare, the OPV vaccine, which contains weakened poliovirus, can mutate and potentially cause paralysis. The oral or drop vaccine protects the gastrointestinal mucosa, but only against poliovirus types 1 and 3. Therefore, infants who have received the oral vaccine must still receive the injected polio vaccine to protect against the more virulent type 2 poliovirus. Therefore, even after receiving OPV, the IPV is still necessary because both have distinct and complementary benefits. The combination of OPV and IPV is very helpful in maximizing polio transmission prevention (Faith *et al*., 2020; Gebremedhin *et al*., 2023).

Globally, wild poliovirus cases have decreased by almost 99% since the launch of the Global Polio Eradication Initiative (GPEI) in 1998 (Tarawally *et al*., 2024). However, around 2013, the disease re-emerged in several countries around the world, especially in four WHO regions (Africa, the Eastern Mediterranean, Southeast Asia, and the Western Pacific) (Tamir *et al*., 2024), which ultimately led to an outbreak. Therefore, WHO recommends that all countries that have only provided OPV include at least 1 (one) dose of IPV vaccine in the routine immunization schedule (Dolan *et al*., 2017; Faith *et al*., 2020; Lopez *et al*., 2018). In several countries in Southeast Asia, such as Indonesia and Myanmar. Polio cases were found in the Philippines and Malaysia, where 12 cases of VDPV type 1 polio and 14 cases of VDPV type 2 polio were reported in the 2018-2022 period. 19 environmental samples were also found to be positive for VDPV-1, and 23 environmental samples were positive for VDPV-2 (Kusumaratna *et al*., 2024). The emergence and spread of type 2 poliovirus derivatives in African and Asian countries resulted in 533 cases of paralytic poliomyelitis during 2017-2019 and 1,079 cases in 2020, thus becoming a major setback in the implementation of the Global Polio Eradication Initiative (Estivariz *et al*., 2023). On the other hand, Indonesia is a high-risk area for polio transmission (Kusumaratna *et al*., 2024), so the potential for a polio outbreak is still very large, even though Indonesia has been declared polio-free since 2014 (Tarawally *et al*., 2024).

In Indonesia's national immunization program, the OPV vaccine is administered free of charge in four doses to infants aged 1-4 months, with a one-month interval. Since 2016, the government has gradually introduced IPV vaccination as a mandatory vaccination program, as it was previously an optional vaccination program requiring payment. The introduction of IPV is part of the national government's efforts to increase protection and eliminate the spread of polio. The first dose of IPV is administered to infants aged 4 months, and since 2023, a second dose of IPV has been added to infants aged 9 months, along with the Measles-Rubella (MR) vaccine. The administration of inactivated poliovirus vaccine (IPV) with oral poliovirus vaccine (OPV) can accelerate the control of outbreaks of virulent poliovirus derived from polio vaccine type 2 (cVDPV) (Estivariz *et al*., 2023). In countries prone to outbreaks, combining the OPV and IPV vaccines maximizes the benefits of both and ensures stronger protection

(Gebremedhin *et al*., 2023). Administration of a dose of IPV after several doses of bivalent OPV protects against poliovirus type 2 in 49%–80% of previously unvaccinated infants and increases titers for serotypes 1 and 3 without altering the high seroconversion rates achieved with bivalent OPV (Estivariz *et al*., 2023). The Polio Eradication Endgame Plan also outlined a strategy for poliomyelitis eradication through a switch from oral poliovirus vaccine (OPV) to inactivated poliovirus vaccine (IPV) (Tamir *et al*., 2024) with at least one dose of IPV in addition to the existing OPV (Gebremedhin *et al*., 2023) in routine immunization campaigns as recommended by WHO (Tamir *et al*., 2024).

Although Indonesia has successfully eradicated wild poliovirus since 2005 through strengthening immunization programs and strong AFP surveillance, and was declared polio-free in 2014, the facts show that several cases of polio have been reported and have become outbreaks. Initially, it occurred in late 2022 in Aceh with an outbreak of type 2 polio, in Purwakarta district, West Java province, in early 2023, and at the end of 2023, several cases of type 2 polio were found in Central Java and East Java provinces (Tarawally *et al*., 2024). Although the immunization program requires the administration of 4 doses of OPV vaccine to every infant, cases of polio or AFP outbreaks still occur sporadically, which triggers a rapid response in the form of mass immunization. The government's follow-up effort is to simultaneously implement the Polio SubPIN in the provinces of Central Java, East Java, and parts of the Yogyakarta province in early 2024, targeting all children under 7 years old with two doses of nOPV-2 vaccine to combat the type-2 poliovirus outbreak. SubPIN polio is an effort to prevent disease outbreaks through mass immunization in certain areas that are considered high risk or that are experiencing polio outbreaks. One factor suspected of triggering the polio outbreak is the low IPV vaccination coverage in recent years. In addition to not reaching the 95% target, in several areas the achievement is still below 50%.

Various studies have identified several factors that can trigger polio outbreaks, including low polio immunization coverage, poor environmental sanitation, poor hygiene and health practices, and a lack of public awareness of the importance of immunization. The risk of transmission increases when public health status is poor and the immune system is weak. Access to sanitation, population density, forest cover, and routine vaccination coverage are the strongest predictors of polio incidence, although the relative magnitude of the effects is not always consistent geographically. Furthermore, the frequency of polio cases also depends on population size and demographics (Noori *et al*., 2017). Efforts to minimize the risk of polio can be made by identifying the geographic distribution of unvaccinated children and areas with a high potential for non-vaccination. The results of this analysis can be used to determine the distribution of disease incidence based on geographic region and other related environmental factors (Uthman *et al*., 2017). Effective interventions to break the chain of transmission emphasize maintaining hand hygiene, access to clean drinking water and sanitation, strengthening routine immunizations, and efforts to build public trust in vaccines to increase awareness and demand for vaccination (Sultan, 2022). Based on this description, this study aims to analyse the influence of children's conditions, perceptions, parental hygiene practices, and the house's physical conditions on the use of the first dose of IPV vaccine.

Method

This research is a quantitative study using a cross-sectional approach, with the unit of analysis being children under 7 years old who are the targets of the SubPIN Polio program in Central Java province in 2024, who are also the target population of the research. The selected sample size is 1069 children from 15 districts/cities that are the locus of the Rapid Convenience Assessment (RCA) activity, which is a monitoring tool for community-level immunization campaigns. The selected districts/cities that are the locus of RCA in Central Java province in 2024 include: Magelang district, Temanggung district, Tegal district, Jepara district, Rembang district, Grobogan district, Klaten district, Wonogiri district, Purworejo district, Banyumas district, Banjarnegara district, Kebumen district,

Pekalongan city, Magelang city, and Pekalongan city.

Primary data collection was conducted through home visits for interviews using structured questionnaires and direct observation. The observation method was used to identify immunization status using the KIA Handbook and to identify the physical condition of the house. Secondary data were obtained through immunization performance achievement reports, health profiles, and so on. Accidental sample collection used inclusion criteria, namely children aged <7 years, living in the local area, having a KIA Handbook, and being willing to be respondents. Because the unit analysis was children aged <7 years, the respondents were their parents (mothers). Data were analyzed univariately in the form of frequency distribution, bivariately using the Chi-Square test, and multivariate analysis using multiple logistic regression because the results of the normality test showed that all variables were not normally distributed. Variables included in the multivariate modelling were variables whose bivariate test results obtained a p-value <0.25 and were analyzed step by step using the "enter" method to obtain a fixed multivariate model. This research has also fulfilled ethical requirements through a certificate of passing ethical review issued by the Committee of Health Research Ethics of the Public Health Faculty, Universitas Diponegoro, Number: 200/EA/KEPK-FKM/2025.

The dependent variable of the study was the utilization of the first dose of IPV immunization, while the independent variables included: child condition factors, immunization perceptions, parental hygiene practices, and the house's physical condition. The child condition factor variable was measured by Birth Weight (BW), Exclusive Breastfeeding status, frequency of illness, history of chronic disease, and OPV immunization status. The parental hygiene practice variable and the physical condition of the house were construct variables measured through many components that became indicators. The parental hygiene practice component was measured through indicators of opening windows, cleaning the house and yard, draining the bathtub, handwashing habits with soap, and defecation behavior. The house's physical condition variable component included indicators of the condition of windows, ceilings, roofs, walls, floors, ventilation, clean water supply, clean water disposal systems, bathrooms/toilets, latrines, types of latrines, and lighting conditions of the house.

Result and Discussion

Based on the characteristics, it is known that the average maternal age is 32.4 years (SD 6.6 years) and the age at the last birth is 28.7 years (SD 6.1 years). The average family income per month is Rp. 2,255,251.14 (SD 1,393,049.2) with a minimum income of Rp. 300,000 and a maximum of Rp. 15,000,000. The number of children is around 1-2. Most have a high school education (46.7%), followed by junior high school (26.3%), with work as a housewife (72.7%). Based on the children's characteristics, it is known that the average age of children is 2.99 years (SD 1.8 years), and most are female. The average of babies' weight at birth (BBL) is 3054.72 grams (SD 474.27 grams) with a body length of 48.58 cm (SD 13.03 cm). A total of 73.7% of babies were delivered vaginally, and the remainder (26.3%) by caesarean section. Furthermore, the average gestational age at the last birth was 38.42 weeks (SD 2.08 weeks).

Table 1 shows an overview of children's immunization status, specifically regarding the fulfilment of oral polio (OPV) and injectable polio (IPV). Of the 1,069 children sampled, the proportion of children who had received the OPV first dose (OPV-1) was 98.6%, given at one month of age, and tended to continue to decline along with the utilization of follow-up OPV vaccines given at 2, 3, and 4 months of age. Coverage of the fourth dose of OPV vaccine was 87.4%, and coverage of the complete OPV vaccine, fulfilling all 4 doses, was 85.9%. Coverage of the first dose of injectable polio vaccine (IPV-1) given to infants aged 4 months was 83.6%. This coverage figure is still lower than the national target of 95%. There is a difference in the coverage of OPV-4 and IPV-1 even though both types of antigens in the national immunization program are given simultaneously at the same age (4 months), with a difference of 3.8%. There are indications that parents do not administer the IPV vaccine together with the OPV-4 vaccine for various

TABLE 1. The Frequency Distribution of Polio Vaccination in Children Aged 12-23 Months

Vaccine's type	Yes		Not	
	N	%	N	%
OPV-1	1054	98.6	15	1.4
OPV-2	1023	95.7	46	4.3
OPV-3	961	89.9	108	10.1
OPV-4	935	87.4	135	12.6
OPV-Complete	918	85.9	151	14.1
IPV-1	894	83.6	175	16.4

TABLE 2. The Relationship Analysis of Independent Variables with IPV Immunization Utilization

Variables	Utilization of IPV Immunization				Sig.
	Not		Yes		
	N	%	N	%	
Birth weight (BW)					
< 2500 grams	21	23.3	69	76.7	0.086
≥ 2500 grams	154	15.7	825	84.3	
Exclusive breastfeeding					
Not exclusive	33	17.9	151	82.1	0.478
Exclusive	142	16.0	743	84.0	
Frequency of child illness					
Often	12	13.2	13.2	86.8	0.478
Rarely	163	16.7	16.7	83.3	
History of chronic illness					
Have a chronic illness	2	8.0	23	92.0	0.379
Not have a chronic illness	172	16.7	861	83.3	
Status of OPV immunization					
Not complete	83	55.0	68	68	0.000*
Complete	92	10.0	826	826	
Perception					
Poor	88	18.2	18.2	81.8	0.170
Good	87	14.9	14.9	85.1	
Parental hygiene practices					
Poor	92	20.4	358	79.6	0.003*
Good	83	13.4	536	86.6	
The house's physical condition					
Not up to standard	87	19.3	363	80.7	0.032*
Up to standard	88	14.2	531	85.8	

*Significant at p value <0.05

reasons. The polio vaccination drop-out rate is also quite high, namely 11.29%, which is much higher than the maximum figure of 10% (WHO standard).

Table 2 shows the results of bivariate analysis where in the group of children who did not utilize IPV immunization there was a tendency for those with BBL < 2500 grams (23.3%), not exclusively breastfed (17.9%), children who were rarely sick and did not have chronic diseases (16.7%), incomplete OPV immunization status (55%), poor perception of immunization (18.2%), poor parental hygiene practices (20.4%) and poor physical condition of the house (19.3%). From the Chi-Square test, it was seen that variables that were statistically related to IPV-1utilization ($p<0.05$) were: complete OPV immunization status ($p = 0.000$), parental hygiene practices ($p = 0.003$), and the house's physical condition (0.032). The variables of Birth Weight (BW), Exclusive breastfeeding, frequency of illness, history of chronic disease, and perception of immunization were proven to be unrelated to the IPV-1 utilization.

The multivariate testing with multiple logistic regression proved that OPV status, parental hygiene practices, and the house's physical condition jointly influenced IPV-1 utilization with an overall effect size of 27% (from an R2 value of 0.270). The greatest variable influence was OPV immunization status, followed by parental hygiene practices and the house's physical condition. An Exp(B) value of 3.543 indicates that the chance of increasing IPV-1 utilization will increase 3.543 times greater if the child's OPV immunization status is complete. The chance of IPV-1 utilization will increase 2.022 times greater if parental hygiene practices are good, and will increase 1.560 times greater if the house's physical condition is also good and up to standard (see Table 3).

The study results showed that the proportion of IPV-1 utilization was 83.6% and had not reached the national target of 95%. The study result was relatively similar to other studies in Central Java province, namely 74.3%, with influencing factors mainly being previous immunization status (HB-0, DPT/HB/HiB, and OPV), attitudes towards immunization, and sources of information about immunization (Sriatmi, Martini, Patriajati, Budiyono, *et al*., 2024). According to the Ministry of Health provisions, as many as 4 doses of OPV vaccine and 1 dose of IPV are included in the routine immunization schedule. Although specifically the coverage of IPV, which was introduced since 2016, has increased, nationally the achievement is still below 80% (Kusumaratna *et al*., 2024). Low IPV immunization coverage is inseparable from the behavior of mothers in bringing their babies for immunization and cultural factors that have been proven to influence IPV utilization, as a study in Aceh Besar (Yarah *et al*., 2025). A similar study in Bangladesh showed similar results, with only 65% receiving IPV at the same visit as OPV, a proportion of approximately 86%. Of the infants not receiving IPV, 58% were due to the unavailability of the vaccine (Estivariz *et al*., 2017). A study of at-risk populations in Ethiopia found that only 31.5%–34% of children received both OPV-3 and IPV, with significant disparities among wealthier children (Gebremedhin *et al*., 2023).

In the national immunization program,

TABLE 3. The Result of Multivariate Analysis

Variables	B	SE	Wald	df	Sig.	Exp(B)	95% CI for Exp(B)	
							Lower	Upper
Status of OPV immunization.	1.265	0.108	136.049	1	0.000*	3.543	2.865	4.382
Parental hygiene practices	0.704	0.211	11.173	1	0.001*	2.022	1.338	3.056
The house's physical condition	0.444	0.209	4.510	1	0.034*	1.560	1.035	2.351
Constant	-3.645	0.439	62.228	1	0.000	0.031	-	-

*Significant at p value <0.05 The value of Nagelkerke R Square = 0.270

the first dose of IPV immunization is given to every child of 4 months old with another four doses of vaccines (OPV-4, DPT/HB/HiB-3, PCV-2 and Rotavirus), so at that age the baby receives multiple vaccinations and more than one injection (multiple injections) because the IPV, DPT/HB/HiB and PCV vaccines are given in the form of intramuscular injections with the injection site generally in the anterolateral thigh, while the OPV and rotavirus vaccines are given in the form of drops. The second dose of IPV (IPV-2) vaccine is given to children aged 9 months along with the MR vaccine administration in an injection form. This condition is often the reason why many parents do not provide complete immunizations according to the type of antigen and age period. There is a tendency for parents to refuse vaccinations, especially multiple injections. A study in the Philippines also showed that only 84% of parents received multiple injections (Lopez *et al*., 2018). The reasons often cited include fear of side effects (Cintyamena *et al*., 2021; Gebremedhin *et al*., 2023; Habib *et al*., 2023), anxiety about the injections (Ezezika *et al*., 2022; Taddio *et al*., 2022), distrust of vaccine safety, dissatisfaction with the vaccination services received (Gebremedhin *et al*., 2023; Habib *et al*., 2023) and the belief that immunizations are useless (Riaz *et al*., 2018) or can be replaced with traditional remedies such as honey and herbal medicine, in addition to religious beliefs that consider vaccines to be haram (Syiroj *et al*., 2019). Anxiety about the side effects of multiple injection vaccinations is felt not only by parents but also by health workers (Dolan *et al*., 2017).

Theoretically, OPV vaccination complements IPV. A cluster-randomized trial in Pakistan demonstrated that the highest serum poliovirus type 1 antibody levels were observed in the group receiving OPV+IPV. The Poliovirus type 2 and type 3 titers were higher in the group receiving routine OPV doses compared to those receiving irregular doses. The IPV boosters after at least two doses of OPV have the potential to fill the immunity gap in areas where OPV has not shown high efficacy, while IPV only slightly enhances humoral immunity and does not provide intestinal immunity (Habib *et al*., 2023). In conclusion, the OPV vaccine builds immunity in the gastrointestinal tract and blood, while the IPV vaccine builds strong immunity in the blood, although it is not as effective as OPV in protecting the digestive tract. This combination is highly beneficial in developing countries with unfavorable environmental conditions, given that poliovirus transmission is generally oral-oral or fecal-oral. IPV administration complements the protection provided by OPV, especially in countries at high risk for polio outbreaks, including Indonesia. The IPV vaccine provides additional, stronger protection against type-2 poliovirus infection.

The low IPV vaccination utilization is caused by many factors. Studies show that the completeness of OPV vaccination, parental hygiene practices, and the house's physical condition influence IPV utilization, either partially or simultaneously. Children who have received a complete OPV vaccination (4 doses) are more likely to accept IPV vaccination because they have experienced the benefits of vaccination, including OPV, such as fewer illnesses. Conversely, children with incomplete OPV vaccination are less likely to utilize IPV vaccination due to the perception that OPV and IPV are the same. Different studies also prove that children's immunization status partially or simultaneously influences compliance with IPV vaccination (Sriatmi, Martini, Patriajati, Budiyono, *et al*., 2024). Lack of parental knowledge and perceptions leads to misunderstandings about the differences between OPV and IPV, even though they both aim to prevent polio. Educational factors, parental knowledge and understanding of vaccines, and socioeconomic determinants influence the refusal of IPV vaccination and routine immunization in children, as shown in a study in Pakistan (Soofi *et al*., 2023). A study in Uganda also showed that IPV acceptance is due to strong encouragement from health workers, distance and easy access to immunization services, and the educational level of caregivers, which leads them to consciously seek immunization services for their children (Faith *et al*., 2020).

Hygiene practices relate to parental behavior in ensuring their children's personal hygiene, their families, and their living

environment. Good hygiene directly and indirectly reduces the risk of transmitting dangerous diseases that can spread due to poor environmental conditions, such as polio. Clean and healthy living behaviors such as washing hands with soap, defecating in a toilet, regularly draining the bathtub, cleaning the house and yard, and also opening windows every morning can reduce the potential risk of poliovirus transmission. Hygiene practices are also associated with greater efforts in awareness to maintain children's health through receiving complete immunizations, including IPV immunization. Parents who maintain good personal hygiene for their children and their environment tend to have a positive attitude towards vaccination compared to those who practice poor hygiene. Studies in India have shown that poliomyelitis is highly contagious and is strongly associated with poor sanitation conditions and a lack of clean drinking water, especially among poor communities (Madhekar, 2020). These results are also in line with Noori *et al*.'s study, which showed that access to sanitation, population density, and routine vaccination coverage are the main predictors of poliomyelitis incidence (Noori *et al*., 2017).

The house's physical condition is related to meeting the requirements for a healthy house as set by the Ministry of Health. The house's physical condition is also related to poverty levels. Poor families generally have houses that do not meet physical standards and are also less likely to utilize all immunization services, including IPV. Studies in Nigeria show that unvaccinated children tend to have mothers with low formal education, who are unemployed, live in poor households and in unhygienic environments, and have higher rates of illiteracy (Uthman *et al*., 2017). The OPV and IPV vaccine coverage favors the wealthy, as in studies in Ethiopia. Children from the poorest households, living in villages without health facilities and with limited access, are less likely to utilize immunization (Gebremedhin *et al*., 2023). Studies in Pakistan have shown that education, knowledge, and socioeconomic determinants influence OPV and IPV vaccine refusal, necessitating effective interventions to address knowledge gaps and misunderstandings among parents (Soofi *et al*., 2023). The variations of geographic, demographic, socioeconomic, and environmental factors are associated with poliovirus transmission patterns and poliomyelitis incidence in a region or country (Noori *et al*., 2017). Topographic complexity, a large and diverse population, an under-managed healthcare system, and frequent family migration are reasons why India has failed to achieve its polio eradication target (Madhekar, 2020).

The parents play a crucial role in the decision to vaccinate their children. Therefore, understanding the benefits of immunization and providing accurate information about it is crucial to prevent misunderstandings and misinformation. Providing education to parents about the importance of maintaining personal, family, and environmental hygiene, as well as strategies for preventing infectious diseases through vaccination, is a key factor in increasing the understanding of poliomyelitis risk, thus increasing parental motivation to fully immunize their children. Knowledge, attitudes, perceptions (especially regarding multiple injections), and positive motivation are important factors in changing parental behavior regarding immunization compliance (Sriatmi, Martini, Patriajati, & Budiyono, 2024). Health information sources are primarily health workers and regional health cadres, who play a crucial role in immunization education (Kusumaratna *et al*., 2024). Parental acceptance of single-shot injections or multiple injections is associated with positive recommendations and good communications from health care providers to parents (Dolan *et al*., 2017). Furthermore, increasing polio immunization coverage also requires collaboration between stakeholders and the community, particularly in making decisions about prioritizing immunization programs. Implementation still requires cross-sectoral support, particularly from the non-health sector. Therefore, for polio immunization to be well-received by the community, a massive, community-based campaign is required (Cintyamena *et al*., 2021) and consistent multi-sectoral involvement. Multi-sector partnerships play a crucial role in maintaining polio immunization coverage (Azizatunnisa' *et al*., 2021).

Positive parental behavior contributes to increased immunization coverage and completeness, including polio vaccination (OPV and IPV). Furthermore, maintaining personal, family, and environmental sanitation and hygiene practices also contributes to improved health status. Barriers caused by a lack of understanding and negative perceptions about vaccines and other health services can be addressed through ongoing outreach and information dissemination. Interventions using a personal communication approach are a straightforward and effective strategy for addressing heterogeneous community characteristics. The most appropriate Information and Education Communication (IEC) model to address various barriers to IPV vaccination is an integrated, community-centered model that emphasizes local and cultural contexts, is tailored to community characteristics, and involves other stakeholders. From the supply side, ensuring the availability of needed vaccines, avoiding stockouts, and effective cold chain management are key factors in successfully increasing IPV vaccination utilization.

Conclusion

Not all children receive IPV vaccination, even though they have received the OPV vaccine. The percentage of children receiving the OPV vaccine also tends to decrease as the required dose increases (4 doses). The OPV immunization status, parental hygiene practices, and the house's physical condition influence IPV vaccine utilization, both partially and simultaneously. The OPV immunization status is the largest predictor, followed by parental hygiene practices and the house's physical condition. Low parental knowledge and awareness of healthy behaviors often lead to misunderstandings and misinformation about vaccines and immunization. More intensive outreach regarding IPV vaccination is needed through personal communication interventions that can also motivate parents. Strengthening the vaccination service system through the provision of vaccine stocks and cold chain management as needed, regulatory support, involvement of relevant stakeholders, and effective IEC are key factors in the success of IPV vaccination.

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