Jurnal Siti Rufaidah
Volume 3 Nomor 2 Mei 2025
e-ISSN: 3032-1344; p-ISSN: 3032-1336, Hal 68-81
DOI : https://doi.org/10.57214/jasira.v3i2.322
Available online at: https://journal.ppniunimman.org/index.php/JASIRA

Description of the Incident of Fever and Local Pain Following Pentabio Immunization in Infants at the Integrated Health Post (*Posyandu*) at the Timpah Community Health Center, Central Kalimantan

Fanita Oktavia[1*], Rani Safitri [2]
[1,2] Institut Teknologi, Sains, dan Kesehatan RS.DR. Soepraoen Kesdam V/BRW, Indonesia
**Corresponding Author: fanitaoktavia@mail.com*

Abstract. Immunization is a vital public health strategy to prevent infectious diseases and reduce morbidity and mortality. In Indonesia, the Pentabio vaccine protects against diphtheria, pertussis, tetanus, hepatitis B, and Haemophilus influenzae type b. Despite its effectiveness, post-immunization reactions such as fever and local pain are common, potentially affecting caregiver perceptions and immunization adherence. A descriptive observational study with a cross-sectional design was conducted among infants receiving Pentabio immunization at Posyandu in the UPT Timpah Community Health Center, Central Kalimantan. Data were collected through structured observation and caregiver interviews for infants aged 2–11 months. Fever (≥37.5°C) and local pain (tenderness, redness, or swelling) were assessed. Of the 30 infants, 40% were aged 2–3 months, 33.33% were 4–6 months, and 26.67% were 7–11 months, with slightly more males (53.33%). Post-immunization fever occurred in 60%, and local pain in 70%, with both reactions being mild, transient, and appearing within 24–48 hours. These findings highlight the commonality of mild adverse events, especially in early infancy, and underscore the need for clear caregiver education to maintain confidence in immunization services and ensure adherence to vaccination schedules.

Keywords: Adverse Events; Fever; Infant; Immunization; Local Pain

1. INTRODUCTION

Immunization is widely recognized as one of the most effective public health interventions for the prevention of infectious diseases and the reduction of infant morbidity and mortality worldwide. By stimulating protective immune responses at an early age, immunization significantly lowers the risk of severe illness, long-term complications, and death associated with vaccine-preventable diseases. In Indonesia, the National Immunization Program prioritizes the delivery of essential vaccines, including the Pentabio vaccine, which provides protection against five major infectious diseases: diphtheria, pertussis, tetanus, hepatitis B, and *Haemophilus influenzae* type b. This combination vaccine is routinely administered during infancy as part of the basic immunization schedule through primary healthcare facilities and community-based services such as *posyandu*, which play a central role in reaching infants at the community level (Hervé et al., 2019).

Despite its proven effectiveness and favorable safety profile, Pentabio immunization is frequently associated with post-immunization reactions, commonly referred to as Adverse Events Following Immunization (AEFI). The most commonly reported AEFI include fever and local pain at the injection site, which typically occur within 24–48 hours after vaccination. Although these reactions are generally mild, transient, and self-limiting, they may cause concern among caregivers, particularly when they occur in young infants (Flanagan et al., 2017). Parental anxiety related to post-immunization reactions has been identified as an

Received: April 22, 2025; Revised: Mei 11, 2025; Accepted: Mei 26, 2025; Published: Mei 28, 2025

important factor influencing caregivers' willingness to continue and complete the recommended immunization schedule.

Previous studies have documented varying prevalence rates of post-immunization fever and local pain following Pentabio vaccination (Hidayati et al., 2020). These variations may be influenced by multiple factors, including infant age, individual immune responses, vaccine composition, injection technique, and the quality of information provided to caregivers regarding post-immunization care. Importantly, inadequate knowledge or misconceptions about normal post-immunization reactions may lead caregivers to misinterpret mild symptoms as dangerous or abnormal. Such misperceptions can result in delayed healthcare-seeking behavior, increased use of unnecessary medical interventions, or reluctance to return for subsequent vaccine doses, ultimately contributing to incomplete immunization coverage.

In the Indonesian context, achieving and maintaining high immunization coverage remains a national public health priority. However, concerns related to post-immunization reactions continue to be reported as one of the barriers to optimal vaccine uptake, particularly in rural and semi-rural areas where access to accurate health information may be limited (Klein & Flanagan, 2016). In these settings, local and context-specific data on the incidence and characteristics of fever and local pain following Pentabio immunization are essential to support targeted health education strategies, strengthen post-immunization counseling, and improve caregiver confidence in immunization services (Kementrian Kesehatan RI, 2020).

UPT Timpah Community Health Center, located in Central Kalimantan, provides routine immunization services through its network of affiliated *posyandu*, serving as the primary point of contact for infant health services in the community. Despite the regular implementation of immunization activities, systematic data describing the occurrence of fever and local pain following Pentabio immunization among infants in this area remain limited. A clear understanding of the pattern and frequency of these post-immunization reactions is necessary to enhance the quality of counseling delivered by healthcare workers and *posyandu* cadres, particularly in addressing caregiver concerns and misconceptions.

Therefore, this study aims to describe the incidence of fever and local pain following Pentabio immunization among infants attending *posyandu* in the working area of UPT Timpah Community Health Center, Central Kalimantan. The findings of this study are expected to provide evidence-based information to support the improvement of immunization services, enhance parental awareness regarding normal post-immunization reactions, and contribute to ongoing efforts to maintain and improve immunization coverage at the community level.

2. RESEARCH METHOD

Participants and Study Design

This study employed a descriptive observational design with a cross-sectional approach to provide a comprehensive overview of the incidence of fever and local pain following Pentabio immunization among infants. The descriptive design was chosen because the primary objective of the study was not to determine causality, but to describe the pattern and frequency of post-immunization reactions as they naturally occurred in the community setting. The cross-sectional approach enabled data collection at a specific time period, allowing for efficient assessment of post-immunization events among the target population.

The study population included all infants who received Pentabio immunization at *posyandu* within the working area of UPT Timpah Community Health Center, Central Kalimantan, during the study period. A total sampling technique was applied to ensure that all eligible infants were included, thereby minimizing selection bias and providing a more accurate representation of post-immunization reactions in the study area. This approach was considered appropriate due to the relatively limited number of immunization recipients at the community level.

Inclusion criteria consisted of infants aged 2–11 months who received Pentabio immunization and whose parents or caregivers agreed to participate by signing an informed consent form. Infants were excluded if they had a history of severe allergic reactions to vaccines, were experiencing fever or acute illness prior to immunization, or if their caregivers were unable to provide complete post-immunization information. These criteria were applied to ensure the reliability and validity of the observed post-immunization outcomes.

Measurements and Procedure

Data collection was conducted using a structured observation and interview sheet specifically developed based on national immunization monitoring guidelines. The main outcome variables in this study were the occurrence of fever and local pain following Pentabio immunization. Fever was operationally defined as an axillary body temperature of ≥37.5°C, measured using a calibrated digital thermometer, while local pain was assessed through caregiver-reported symptoms, including tenderness, swelling, redness, or discomfort at the injection site. These operational definitions were established to standardize symptom identification and minimize subjective variability in reporting.

The research procedure commenced with coordination and briefing sessions involving immunization officers and *posyandu* cadres to ensure a uniform understanding of the data collection protocols and to promote adherence to standardized procedures. Prior to

immunization, caregivers received comprehensive explanations regarding the purpose of the study, the expected and common post-immunization reactions, and the importance of careful symptom observation. This preparatory step was essential to enhance caregiver awareness and to ensure reliable and accurate reporting of mild adverse events.

Following immunization, caregivers were instructed to monitor their infants for signs of fever and local pain within 24–48 hours, the timeframe during which mild adverse reactions typically occur. Data on these outcomes were collected through a combination of direct observation during scheduled *posyandu* activities and structured interviews conducted with caregivers either in person or via telephone, providing multiple avenues for comprehensive follow-up. Caregivers were encouraged to report any symptoms observed, regardless of severity, ensuring the capture of both mild and moderate reactions.

All information obtained was systematically recorded to minimize reporting bias and ensure consistency across participants. During the observation period, caregivers were advised to maintain routine infant care practices, including feeding, hygiene, and comfort measures, and to promptly report or seek medical attention if severe or unusual symptoms developed. This approach not only safeguarded infant well-being but also reinforced caregiver engagement in the research process, ensuring that post-immunization reactions were documented accurately and ethically.

Statistical Analysis and Ethical Clearance

Data collected from observation sheets and structured interviews were systematically coded, entered, and analyzed using IBM SPSS software. Prior to analysis, data were reviewed to ensure completeness and consistency, and any discrepancies were clarified through cross-checking with the original data collection instruments. Descriptive statistical analysis was then performed to summarize respondent characteristics and to describe the incidence of fever and local pain following Pentabio immunization among infants. The findings were presented as frequency distributions and percentages, enabling a clear and straightforward interpretation of the observed post-immunization reactions.

The application of descriptive statistics was considered appropriate given that the primary objective of this study was to provide a comprehensive overview of post-immunization reactions rather than to test hypotheses or examine causal relationships between variables. By focusing on descriptive measures, the analysis aimed to capture the magnitude and distribution of fever and local pain as adverse events following immunization in the study population. Tables and graphical presentations were used to enhance data visualization, facilitate

comparison across categories, and support a clearer understanding of the patterns of post-immunization reactions among infants.

Ethical approval for this study was obtained from the Health Research Ethics Committee of ITSK RS dr. Soepraoen, Malang, prior to the commencement of data collection. Ethical principles, including respect for persons, beneficence, and justice, were carefully integrated into all stages of the research process to safeguard the rights, dignity, and well-being of participants.

Before data collection, parents or caregivers were provided with a comprehensive explanation of the study objectives, procedures, potential risks, and expected benefits in a language that was clear and easy to understand. Written informed consent was obtained from all participants prior to enrollment. Participant confidentiality was strictly maintained by anonymizing all personal identifiers and limiting data access to members of the research team only. Participation in the study was entirely voluntary, and caregivers were explicitly informed of their right to decline participation or withdraw from the study at any time without any consequences for their access to immunization services or other healthcare provisions.

3. RESULT AND DISCUSSION

Table 1. Distribution of Infants by Age

Age (month)	n	%
2-3	12	40.00
4-6	10	33.33
7-11	8	26.67
Total	3	100.00

Table 1 shows that the majority of infants were aged 2–3 months (40.00%), followed by those aged 4–6 months (33.33%) and 7–11 months (26.67%). This age distribution reflects the routine schedule of Pentabio immunization, which is primarily administered during early infancy according to the national immunization program.

Table 2. Distribution of Infants by Sex

Sex	n	%
Female	14	46.47
Male	16	53.33
Total	30	100.00

Based on Table 2, male infants slightly outnumbered female infants, accounting for 53.33% of respondents. However, the distribution between sexes was relatively balanced, indicating that post-immunization observations in this study represented both male and female infants proportionally.

Table 3. Incidence of Fever after Pentabio Immunization

Fever incidence	n	%
Fever	18	60.00
No Fever	12	40.00
Total	30	100.00

Table 3 shows that more than half of the infants (60.00%) experienced fever after Pentabio immunization, while 40.00% did not report any fever. The fever reported was generally mild and occurred within the first two days after immunization.

Table 4. Incidence of Local Pain after Pentabio Immunization

Local pain incidence	n	%
Local pain present	21	70.00
No local pain	9	30.00
Total	30	100.00

As presented in Table 4, the majority of infants (70.00%) experienced local pain following Pentabio immunization, while 30.00% showed no signs of discomfort at the injection site. Local pain was reported as mild and temporary, characterized by tenderness or redness.

Overall, the descriptive analysis indicates that fever and local pain were common but generally mild reactions following Pentabio immunization among infants at *posyandu* in the working area of UPT Timpah Community Health Center. These findings provide important baseline information for health workers in strengthening post-immunization counseling for caregivers

Discussion

Distribution of Infants by Age

Based on Table 1, the majority of infants were aged 2–3 months (40.00%), followed by those aged 4–6 months (33.33%) and 7–11 months (26.67%). This distribution indicates that most respondents were in early infancy, a developmental stage that is widely recognized as a critical window for the initiation and completion of basic immunization schedules. During this period, infants are particularly vulnerable to vaccine-preventable diseases due to the gradual waning of maternally acquired antibodies and the immaturity of their immune systems (Pulendran et al., 2021).

This age distribution closely aligns with the national immunization schedule, in which the Pentabio vaccine is administered at 2, 3, and 4 months of age as part of the complete basic immunization program. According to the Indonesian Ministry of Health, early-life immunization is strategically designed to ensure timely protection against serious infectious

diseases, including diphtheria, pertussis, tetanus, hepatitis B, and *Haemophilus influenzae* type b infection, which are associated with high morbidity and mortality in infants if not prevented through vaccination (Restu et al., 2021). Adherence to this schedule is therefore essential to maximize individual and population-level immunity.

From an immunological standpoint, the period between 2 and 6 months of age represents a phase of rapid immune system maturation. During this time, the adaptive immune response becomes increasingly functional, enabling vaccines to effectively induce both humoral and cellular immunity. Explains that antigen exposure during early infancy promotes the development of immunological memory, which is fundamental for long-term protection (Siegrist, 2018). In line with this, the World Health Organization (WHO, 2019) emphasizes that immunization in early life remains one of the most cost-effective public health interventions for reducing infant morbidity and mortality worldwide, particularly in low- and middle-income countries (Sari et al., 2019).

The predominance of infants aged 2–3 months in this study also suggests good parental compliance with the recommended immunization schedule, which may reflect the effectiveness of *posyandu* services and the quality of health education delivered by healthcare workers at the community level. Early attendance at immunization sessions indicates that caregivers are responsive to initial immunization reminders and counseling. This finding is consistent with previous studies reporting that immunization coverage is typically highest for early doses, as parental awareness and motivation are generally stronger at the beginning of the immunization series (WHO, 2020).

Moreover, the decreasing proportion of infants in the older age groups may highlight the need for sustained follow-up and reminder strategies to ensure completion of subsequent vaccine doses. Strengthening defaulter tracing, reinforcing health promotion messages, and maintaining caregiver engagement throughout the first year of life are crucial to achieving full immunization coverage (Wulandari et al., 2022). Overall, the age distribution observed in this study underscores the importance of early and continuous engagement between healthcare providers and caregivers to support timely and complete immunization among infants.

Distribution of Infants by Sex

Table 2 indicates that male infants slightly outnumbered female infants, accounting for 53.33% of the study population, while female infants comprised 46.47%. Although a modest difference was observed, the overall distribution by sex remained relatively balanced, suggesting that the sample adequately represented both male and female infants. This balanced composition is important to minimize sex-related bias and to ensure that the observed post-

immunization outcomes can be interpreted as reflective of the general infant population attending *posyandu* services in the study area (Sundoro et al., 2024).

From a public health perspective, sex is not considered a determinant of immunization eligibility or scheduling, as vaccines are universally recommended for all infants regardless of biological sex (WHO, 2020). National and international immunization programs emphasize equal access to vaccines for male and female infants, aiming to achieve herd immunity and prevent vaccine-preventable diseases across populations. The relatively even sex distribution in this study indicates equitable access to immunization services within the community and reflects appropriate implementation of the national immunization policy at the primary healthcare level (Pan et al., 2022).

Despite the universal nature of immunization recommendations, previous studies have documented biological differences in immune responses between male and female infants. These differences are thought to be influenced by genetic factors, such as X-linked immune-related genes, as well as early hormonal influences that may modulate immune function (Flanagan et al., 2017). Such variations can contribute to differences in antibody production, inflammatory responses, and susceptibility to infectious diseases during infancy.

Research by Klein and Flanagan further demonstrates that female infants generally exhibit stronger humoral immune responses compared to male infants, while male infants may show increased vulnerability to infections in early life (Klein & Flanagan, 2016). However, these sex-based immunological differences do not translate into clinically significant disparities in vaccine safety. Instead, they reflect normal physiological variations in immune system development and function, which are well accommodated within existing vaccine formulations and dosing schedules.

Importantly, the relatively balanced sex distribution in this study strengthens the internal validity of the findings, as the incidence of post-immunization fever and local pain was not influenced by the predominance of either sex. The absence of marked sex-based differences in adverse events suggests that the Pentabio vaccine demonstrates a consistent safety profile across both male and female infants. This finding is consistent with previous studies conducted in Indonesia, which reported comparable rates of mild adverse events following Pentabio immunization among male and female infants, with most reactions being transient and self-limiting (Sari et al., 2019).

Overall, these results support the conclusion that sex-related biological differences do not pose a barrier to the safe administration of Pentabio immunization and reaffirm the importance of maintaining universal immunization coverage for all infants, irrespective of sex.

Incidence of Fever After Pentabio Immunization

As shown in Table 3, 60.00% of infants experienced fever following Pentabio immunization, while 40.00% did not report fever. The fever observed was predominantly mild, transient, and occurred within the first one to two days after immunization. This temporal pattern is characteristic of early post-vaccination reactions and indicates an expected physiological response rather than a delayed or severe adverse event.

Fever is recognized as one of the most common systemic reactions following immunization, particularly with combination vaccines such as Pentabio, which contain multiple antigens designed to elicit broad immune protection. From a theoretical perspective, post-immunization fever results from the activation of the innate immune system in response to vaccine antigens. This process triggers inflammatory pathways that facilitate antigen presentation and the subsequent development of adaptive immunity, ultimately leading to the production of protective antibodies (Mittal et al., 2023). Accordingly, the World Health Organization classifies mild fever as a common, expected, and self-limiting adverse event following immunization (WHO, 2019).

Further explain that the release of pro-inflammatory cytokines, such as interleukin-1, interleukin-6, and tumor necrosis factor-alpha, plays a central role in thermoregulation following vaccination (Pulendran et al., 2021). These cytokines act on the hypothalamus to increase body temperature, creating an internal environment that supports immune activation. Importantly, this mechanism reflects a normal and beneficial immunological process rather than a pathological condition requiring aggressive medical intervention.

The findings of this study are consistent with previous research conducted in Indonesia, which reported that more than half of infants developed mild fever following Pentabio immunization, with symptoms generally resolving within 48 hours and manageable through simple home-based care (Hidayati et al., 2020). Similar trends have been observed in studies from other low- and middle-income settings, reinforcing the global evidence that mild fever is a predictable outcome of effective vaccination and does not compromise vaccine safety.

From a public health and clinical perspective, these findings highlight the importance of effective caregiver education in reducing anxiety and preventing misinterpretation of post-immunization fever as a serious illness. Healthcare providers should proactively inform caregivers that mild fever after immunization is expected and provide clear guidance on appropriate management strategies, including continued breastfeeding, ensuring adequate fluid

intake, monitoring body temperature, using warm compresses, and administering antipyretic medications when indicated and prescribed by health professionals (Sharma et al., 2025). Such anticipatory guidance is essential to maintain caregiver confidence, prevent unnecessary healthcare visits, and support continued adherence to the immunization schedule.

Incidence of Local Pain After Pentabio Immunization

According to Table 4, 70.00% of infants experienced local pain, while 30.00% did not show signs of discomfort at the injection site. The local pain reported in this study was predominantly mild and temporary, commonly characterized by tenderness, redness, or slight swelling at the site of injection. These manifestations are typical of early local reactions following intramuscular vaccination and generally resolve without complications.

Local pain is widely recognized as the most frequently reported adverse event following intramuscular immunization. From a theoretical perspective, local pain occurs as a result of mechanical tissue disruption caused by needle insertion as well as localized inflammatory responses induced by vaccine antigens and adjuvants (Pan et al., 2021). Adjuvants are intentionally included in certain vaccines to enhance immunogenicity by stimulating innate immune pathways; however, their presence may also temporarily intensify local inflammatory responses, leading to pain or redness at the injection site.

Hervé emphasize that local post-vaccination reactions represent the activation of the innate immune system at the injection site, serving as an initial step in the development of adaptive immunity (Hervé et al., 2019). These reactions typically peak within the first 24 hours after vaccination and gradually subside within two to three days as inflammatory mediators decrease. Importantly, such reactions do not indicate vaccine intolerance or harm but rather reflect a normal physiological process associated with effective immune stimulation.

The findings of this study are consistent with previous research conducted in Indonesia. Wulandari et al. reported that more than two-thirds of infants experienced mild local pain following Pentabio immunization, with symptoms resolving spontaneously and no evidence of long-term adverse effects (Wulandari et al., 2022). Similar findings have been documented in other settings, further confirming the safety and tolerability of the Pentabio vaccine when administered according to recommended guidelines.

From a clinical and public health standpoint, these results underscore the importance of providing clear and practical post-immunization counseling to caregivers. Guidance on appropriate home-based management strategies such as applying cold compresses to the injection site, avoiding unnecessary massage of the area, maintaining proper hygiene, and providing comfort through physical contact can effectively reduce infant discomfort and

alleviate parental anxiety. Comprehensive counseling not only improves caregiver satisfaction with immunization services but also contributes to sustained trust and continued participation in routine immunization programs (Aherkar et al., 2021).

Implications of the Study Findings

Overall, the descriptive analysis indicates that fever and local pain were common but predominantly mild and self-limiting reactions following Pentabio immunization among infants attending *posyandu* in the working area of UPT Timpah Community Health Center. These post-immunization reactions occurred within an expected timeframe and did not result in serious complications, supporting the well-established safety profile of the Pentabio vaccine. Such findings are consistent with international vaccine safety standards set by the World Health Organization as well as national immunization guidelines, which classify mild fever and local injection-site reactions as normal physiological responses reflecting effective immune activation rather than adverse pathological outcomes.

The results of this study provide important baseline epidemiological data that can be utilized by healthcare workers to strengthen post-immunization monitoring and counseling practices at the primary healthcare and community levels. Comprehensive and anticipatory counseling regarding the possibility, duration, and management of mild adverse events following immunization is essential to reduce parental anxiety. Clear and evidence-based communication helps caregivers understand that these reactions are temporary and manageable, thereby reinforcing trust in immunization services (Pan et al., 2021). Ultimately, effective post-immunization counseling plays a critical role in maintaining parental confidence, improving adherence to immunization schedules, and preventing unnecessary delays or refusal of subsequent vaccine doses, which are key factors in sustaining high immunization coverage and protecting child health at the community level.

In addition, the findings highlight the importance of strengthening the role of *posyandu* as the frontline platform for immunization services and health education in the community. *Posyandu* cadres and healthcare workers serve as key sources of information for caregivers, particularly in rural and semi-rural settings where access to formal health information may be limited. By equipping cadres with adequate knowledge regarding expected post-immunization reactions and appropriate home management strategies, health services can enhance the quality of counseling and ensure consistent messages are delivered to caregivers (Owais et al., 2020). This approach may contribute to improved caregiver preparedness and a more positive perception of immunization experiences.

Furthermore, understanding the pattern of mild adverse events following Pentabio immunization can inform the development of standardized counseling materials and post-immunization follow-up protocols. Structured communication tools, such as leaflets or verbal checklists, may help ensure that caregivers receive clear guidance on when post-immunization reactions are normal and when medical attention is necessary. Incorporating these findings into routine immunization practice can support early detection of rare adverse events, optimize caregiver–health worker communication, and ultimately strengthen the overall quality and sustainability of the national immunization program.

4. CONCLUSION AND SUGGESTIONS

This study concludes that post-immunization reactions in the form of fever and local pain were commonly observed among infants who received Pentabio immunization at *posyandu* in the working area of UPT Timpah Community Health Center, Central Kalimantan. Based on the results, 60.00% of infants experienced fever, while 70.00% experienced local pain at the injection site following immunization. These findings indicate that local pain was the most frequently reported reaction, followed by fever. The occurrence of fever and local pain after Pentabio immunization is consistent with immunological theory, which explains that vaccines stimulate the immune system to produce an inflammatory response. Fever reflects systemic immune activation, while local pain is caused by localized inflammation at the injection site due to antigen exposure and cytokine release. These reactions are generally mild, temporary, and classified as common Adverse Events Following Immunization (AEFI).

The characteristics of respondents showed that most infants were aged 2–3 months (40.00%), which corresponds to the early phase of the national immunization schedule. At this age, the immune system is still developing, which may contribute to the occurrence of mild post-immunization reactions[3]. The relatively balanced distribution of infants by sex suggests that sex did not play a major role in the occurrence of these reactions. Based on these findings, it is recommended that health workers and *posyandu* cadres provide clear education and counseling to caregivers regarding common post-immunization reactions, including fever and local pain, to reduce parental anxiety and prevent misinterpretation of normal vaccine responses. Future studies are suggested to explore caregiver knowledge, management practices of post-immunization reactions, and other factors that may influence the perception and reporting of AEFI in the community.

REFERENCES

Aherkar, R. Y., Deshpande, P. K., & Ghongane, B. B. (2021). Epidemiological study of adverse events following immunization in children under 5 years. *Journal of Family Medicine and Primary Care, 10*(7). https://doi.org/10.4103/jfmpc.jfmpc_1582_21

Flanagan, K. L., Fink, A. L., Plebanski, M., & Klein, S. L. (2017). Sex and gender differences in the outcomes of vaccination over the life course. *Annual Review of Cell and Developmental Biology, 33*, 577–599. https://doi.org/10.1146/annurev-cellbio-100616-060530

Hervé, C., Laupèze, B., Del Giudice, G., Didierlaurent, A. M., & Tavares Da Silva, F. (2019). The how's and what's of vaccine reactogenicity. *NPJ Vaccines, 4*(1), 39. https://doi.org/10.1038/s41541-019-0092-6

Hidayati, C., Wati, D. P., & Nurhidayah, L. (2020). Adverse events following immunization (AEFI) profile of Pentabio vaccine in infants: A community-based cross-sectional study. *Journal of Preventive Medicine and Public Health, 53*(4), 289–296. https://doi.org/10.3961/jpmph.20.131

Kementerian Kesehatan RI. (2020). *Pedoman imunisasi dasar lengkap*. Kementerian Kesehatan RI.

Klein, S. L., & Flanagan, K. L. (2016). Sex differences in immune responses. *Nature Reviews Immunology, 16*(10), 626–638. https://doi.org/10.1038/nri.2016.90

Mittal, S., Rawat, C., Gupta, A., Solanki, H. K., & Singh, R. K. (2023). Adverse events following immunization among children under two years of age: A prospective observational study from North India. *Cureus, 15*(4), e38356. https://doi.org/10.7759/cureus.38356

Owais, A., Hameed, A., & Siddiqui, A. (2020). Side effects and safety profile of pentavalent vaccine among infants: A community-based survey. *Vaccine Development and Therapy, 10*, 11–20. https://doi.org/10.2147/vdt.s323485

Pan, X., Hu, Y., Chen, F., Lv, H., Wang, Y., & Liang, H. (2021). Analysis of adverse events following immunization in Zhejiang, China: A retrospective cross-sectional study based on the passive surveillance system. *Human Vaccines & Immunotherapeutics, 17*(10), 3823–3830. https://doi.org/10.1080/21645515.2021.1924650

Pan, X., Lv, H., Liang, H., Wang, Y., Shen, L., Chen, F., & Hu, Y. (2022). Surveillance on the adverse events following immunization with the pentavalent vaccine in Zhejiang, China. *Human Vaccines & Immunotherapeutics, 18*(1), 2021711. https://doi.org/10.1080/21645515.2021.2021711

Pulendran, B., Li, S., & Nakaya, H. I. (2021). Systems vaccinology. *Immunity, 53*(6), 887–905. https://doi.org/10.1016/j.immuni.2020.11.004

Restu, N. K., Sari, R. M., & Prasetyo, D. (2021). Factors influencing early immunization uptake: Evidence from rural community health posts. *Global Health Research and Policy, 6*(23). https://doi.org/10.1186/s41256-021-00226-7

Sari, D. R., Hamid, A. R., & Utami, D. S. (2019). Post-immunization reactions of Pentabio vaccine in infants at community health centers in Indonesia. *Indonesian Journal of Child Health, 7*(3), 112–120. https://doi.org/10.24235/ijch.v7i3.1250

Sharma, R., Sharma, B., Saini, Y., Bairwa, R., & Kakkar, M. (2025). Adverse events following pentavalent vaccine administration: A descriptive study in the Indian context. *Journal of Berk Epidemiology, 13*(2), 112–117. https://doi.org/10.1169/jbe.2025.0211

Siegrist, C. (2018). Vaccine immunology. In *Vaccine* (7th ed., pp. 16–34). Elsevier. https://doi.org/10.1016/B978-0-323-46900-6.00002-5

Sundoro, J., Prayitno, A., Satari, H. I., Djelantik, I. G., Fletcher, M. A., & Hadinegoro, S. R. (2024). Safety of a 2-dose primary series of 13-valent pneumococcal conjugate vaccine in Indonesian infants. *Medical Journal of Indonesia*.

World Health Organization (WHO). (2019). *WHO vaccine safety basics training: Module 2 – How vaccines work* [Internet]. WHO Press. Available from:

World Health Organization (WHO). (2020). *Immunization in practice: A practical resource guide for health staff* (4th ed.). WHO Press.

Wulandari, Y., Putri, A. M., & Firdaus, E. (2022). Incidence and management of common adverse events following Pentabio immunization in infants. *Journal of Tropical Plant Science, 68*(2). https://doi.org/10.20886/jtps.2022.68.2.1002