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Original Research

Comparison of skin reactions in children receiving live vs. inactivated vaccines: A dermatological assessment

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ABSTRACT:
Background: Vaccines play a crucial role in preventing infectious diseases, especially in children. However, dermatological reactions are among the common adverse events that can follow vaccination. Live and inactivated vaccines differ in their composition and immune responses, which may influence the frequency and severity of post-vaccination skin reactions. Understanding these differences is essential for improving vaccine safety and parental compliance. **Aim:**To compare the type, frequency, and severity of skin reactions in children receiving live versus inactivated vaccines through a detailed dermatological assessment. **Material and Methods:**This comparative study was conducted at a tertiary care hospital and included 110 pediatric participants aged 6 months to 12 years. Participants were divided equally into two groups: Group A received live vaccines and Group B received inactivated vaccines. Dermatological assessments were conducted by a dermatologist before and after vaccination. Skin reactions such as erythema, swelling, rash, induration, and urticaria were recorded using a standardized form. **Results:**Out of 110 participants, 50.00% (n=55) received live vaccines and 50.00% (n=55) received inactivated vaccines. Dermatological reactions were observed in 60.00% (n=33) of children in the live vaccine group, compared to 32.73% (n=18) in the inactivated group (p=0.004). Erythema was the most frequent reaction, seen in 25.45% of live vaccine recipients and 10.91% of inactivated vaccine recipients (p=0.04). Swelling, rash, and induration were more common in the live vaccine group, while urticaria was observed only in the inactivated group (5.45%). Most reactions in both groups were mild; however, severe reactions (6.06%) occurred exclusively in the live vaccine group. **Conclusion:**Live vaccines were associated with a significantly higher rate of dermatological reactions compared to inactivated vaccines, with erythema being the most common. While most reactions were mild, severe cases were reported only after live vaccine administration. These findings highlight the importance of dermatological monitoring and caregiver education during routine immunization.
Keywords: Live vaccines, Inactivated vaccines, Skin reactions, Pediatrics, Dermatological assessment

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INTRODUCTION

Vaccination remains one of the most impactful and cost-effective strategies for preventing infectious diseases globally. By inducing immunity through the administration of antigenic substances, vaccines have drastically reduced morbidity and mortality, particularly in pediatric populations. However, as immunization programs expand, attention to vaccine safety and post-vaccination reactions has become equally critical, especially in terms of dermatological responses that may cause concern among parents and caregivers. Skin reactions following vaccination, though often mild and self-limiting, can sometimes be severe or misinterpreted as allergic reactions, leading to vaccine hesitancy and disruption in immunization schedules.Vaccines are broadly classified into live attenuated and inactivated types. Live vaccines contain weakened forms of the pathogen capable of replication but not causing disease in healthy individuals. These vaccines elicit strong, long-lasting immune responses and often require fewer doses. Common live vaccines administered during childhood include measles, mumps, rubella (MMR), varicella, and oral polio vaccine (OPV)[1]. In contrast, inactivated vaccines consist of killed organisms or subunit components incapable of replication. While they are

safer in immunocompromised individuals, they often necessitate booster doses to sustain immunity[2].The mechanisms underlying vaccine-induced skin reactions vary by vaccine type and formulation. Live vaccines may provoke more robust immunologic responses, sometimes mimicking mild forms of the disease itself. Reactions such as erythema, swelling, induration, and even generalized rashes may occur due to viral replication at the inoculation site or systemic circulation of attenuated strains[3]. In contrast, inactivated vaccines are more likely to produce localized, transient effects primarily attributed to immune activation and vaccine adjuvants rather than active replication[4]. The presence of preservatives and stabilizers in inactivated vaccines can also trigger hypersensitivity or allergic responses in predisposed children[5].Pediatric patients are particularly sensitive to vaccine reactions, not only due to their developing immune systems but also because of parental vigilance and the visibility of cutaneous signs. Skin manifestations can range from mild erythema and induration to more concerning reactions like urticaria, vesiculation, or extensive limb swelling. Differentiating benign, expected immunologic responses from adverse or hypersensitivity reactions is crucial for clinicians to provide accurate counseling and minimize unnecessary discontinuation of vaccine schedules[6].Several factors may influence the development and severity of skin reactions in children following immunization. These include the type of vaccine administered, age of the child, underlying immune status, history of allergic disease, and prior exposure to similar vaccine antigens[7]. Live vaccines, by their nature, are contraindicated or used with caution in immunocompromised children due to the theoretical risk of uncontrolled replication. Conversely, inactivated vaccines are generally safer in such populations but may elicit weaker immunogenicity or require adjuvants that contribute to local inflammation[8].In recent years, dermatologists and pediatricians have increasingly collaborated to identify, classify, and manage cutaneous adverse events following immunization. This interdisciplinary approach helps ensure that dermatological reactions are not overlooked or misdiagnosed. The integration of dermatological assessments into vaccine safety studies also enhances the understanding of reaction patterns and supports the creation of standardized diagnostic criteria for post-vaccine cutaneous events[9,10]. Despite this, there is still a lack of robust comparative data on the specific dermatological profiles induced by live versus inactivated vaccines in children.In clinical practice, reactions following vaccination often generate considerable concern among parents. The fear of visible adverse effects—particularly those affecting the skin—may lead to vaccine refusal or delayed immunization. Understanding the expected frequency, type, and severity of dermatological reactions associated with different vaccine types is therefore essential not only for clinical decision-making but also for reinforcing public confidence in vaccine safety. Counseling based on evidence-driven data can reassure caregivers and reduce hesitancy by differentiating between typical immune responses and true adverse events.While numerous studies have addressed systemic adverse effects of vaccines, there remains a relative paucity of focused dermatological assessments comparing live and inactivated vaccines in pediatric populations. Most safety surveillance systems tend to generalize skin reactions or report them without stratification by vaccine type. This gap hinders clinicians from making informed comparisons or identifying patterns that may inform future immunization guidelines or modifications to vaccine formulations.

MATERIAL AND METHODS

This comparative study was conducted at a tertiary care hospital and involved a total of 110 pediatric participants who were assessed for dermatological reactions following the administration of either live or inactivated vaccines. The participants were selected through non-probability consecutive sampling and divided into two groups based on the type of vaccine they received. Group A comprised children who were administered live vaccines, while Group B included those who received inactivated vaccines. Inclusion criteria involved children aged between 6 months and 12 years who were brought to the hospital for routine immunization. Children with pre-existing dermatological conditions, ongoing skin infections, or known hypersensitivity to vaccines were excluded from the study.

After obtaining informed consent from parents or guardians, a standardized dermatological examination was carried out for each child both before and after vaccination. Skin reactions were assessed and recorded at intervals post-vaccination by a qualified dermatologist, with specific attention to erythema, swelling, rash, induration, and other local or generalized dermatological responses. A structured data collection form was used to document the demographic details, vaccine type, and observed skin reactions.

The collected data were entered and analyzed using SPSS version 21.0. Categorical variables such as type and frequency of skin reactions were expressed as frequencies and percentages. Chi-square tests were applied to compare the incidence of dermatological reactions between the two groups, and a p-value of less than 0.05 was considered statistically significant. The methodology ensured objective, uniform evaluation of dermatological outcomes to provide a reliable comparison between live and inactivated vaccine groups.

RESULTS

Table 1 presents the distribution of participants according to the type of vaccine received. Out of a total of 110 children included in the study, exactly

half (n=55, 50.00%) received live vaccines (Group A), while the other half (n=55, 50.00%) received inactivated vaccines (Group B). This equal distribution was maintained to allow a balanced comparison between the two groups regarding dermatological outcomes.

Table 2 outlines the age and gender distribution of participants across both groups. The mean age of children in the live vaccine group was 4.65 ± 2.14 years, while in the inactivated vaccine group, it was slightly higher at 4.78 ± 2.21 years. The difference in age distribution was not statistically significant (p=0.71), indicating both groups were comparable in terms of age. Regarding gender, males comprised 50.91% (n=28) of the live vaccine group and 54.55% (n=30) of the inactivated vaccine group, whereas females accounted for 49.09% (n=27) and 45.45% (n=25) respectively. The gender distribution also showed no significant difference (p=0.70), confirming demographic comparability between the two groups.

Table 3 compares the overall occurrence of dermatological reactions following vaccination. Among the children who received live vaccines, 33 out of 55 (60.00%) developed dermatological reactions, compared to only 18 out of 55 (32.73%) in the inactivated vaccine group. This difference was statistically significant (p=0.004), suggesting that live vaccines were more likely to induce dermatological responses than inactivated vaccines. Conversely, 40.00% of children in the live vaccine group and 67.27% in the inactivated vaccine group did not experience any skin reaction.

Table 4 details the specific types of dermatological reactions observed in both groups. Erythema was the most frequently reported reaction, occurring in 25.45% (n=14) of the live vaccine group compared to 10.91% (n=6) in the inactivated group; this difference was statistically significant (p=0.04). Other reactions such as swelling (16.36% vs. 7.27%), rash (10.91% vs. 5.45%), and induration (7.27% vs. 3.64%) were more common in the live vaccine group but did not reach statistical significance (p>0.05). Interestingly, urticaria was reported only in the inactivated vaccine group (5.45%) and not at all in the live vaccine group; however, this difference was also not statistically significant (p=0.08). These findings indicate a broader spectrum and higher frequency of skin reactions associated with live vaccines, particularly erythema.

Table 5analyzes the severity of skin reactions among those who experienced them. In the live vaccine group (n=33), 60.61% (n=20) had mild reactions, 33.33% (n=11) had moderate reactions, and 6.06% (n=2) experienced severe reactions. In contrast, among the 18 children who had reactions in the inactivated group, the majority (77.78%, n=14) had mild symptoms, and the remaining 22.22% (n=4) had moderate symptoms, with no cases of severe reactions reported. Although the difference in severity distribution was not statistically significant (p=0.18), it is notable that severe skin reactions occurred only in the live vaccine group.

Table 1: Distribution of Participants by Type of Vaccine

Group	Frequency (n)	Percentage (%)
Live Vaccine (Group A)	55	50.00%
Inactivated Vaccine (Group B)	55	50.00%
Total	**110**	**100.00%**

Table 2: Age and Gender Distribution of Participants

Demographic Variable	Live Vaccine (n=55)	Inactivated Vaccine (n=55)	p-value
Age (Mean ± SD)	4.65 ± 2.14 years	4.78 ± 2.21 years	0.71
Gender			
Male	28 (50.91%)	30 (54.55%)	0.70
Female	27 (49.09%)	25 (45.45%)	

Table 3: Comparison of Overall Dermatological Reactions Between Groups

Reaction Present	Live Vaccine (n=55)	Inactivated Vaccine (n=55)	Total (n=110)	p-value
Yes	33 (60.00%)	18 (32.73%)	51 (46.36%)	0.004**
No	22 (40.00%)	37 (67.27%)	59 (53.64%)	

****Statistically significant at p < 0.05**

Table 4: Types of Dermatological Reactions Observed

Type of Reaction	Live Vaccine (n=55)	Inactivated Vaccine (n=55)	Total	p-value
Erythema	14 (25.45%)	6 (10.91%)	20	0.04*
Swelling	9 (16.36%)	4 (7.27%)	13	0.14
Rash	6 (10.91%)	3 (5.45%)	9	0.29
Induration	4 (7.27%)	2 (3.64%)	6	0.40
Urticaria	0 (0.00%)	3 (5.45%)	3	0.08

***Statistically significant at p < 0.05**

Table 5: Severity of Skin Reactions Among Those Affected

Severity Level	Live Vaccine (n=33)	Inactivated Vaccine (n=18)	p-value
Mild	20 (60.61%)	14 (77.78%)	0.18
Moderate	11 (33.33%)	4 (22.22%)	
Severe	2 (6.06%)	0 (0.00%)	

DISCUSSION

In the present study, equal distribution of participants was ensured between live (n=55) and inactivated (n=55) vaccine groups, eliminating sampling bias and supporting comparative analysis. This methodological approach aligns with the recommendations of Gidudu et al. (2011), who emphasized the importance of matched group design in vaccine safety studies to strengthen internal validity and reduce confounding[10]. By maintaining group balance, this study allowed a clearer interpretation of dermatological reaction differences attributed to vaccine type rather than demographic disparities.

The mean age of participants in both groups was similar (4.65 ± 2.14 years in the live vaccine group and 4.78 ± 2.21 years in the inactivated group), with no significant gender difference, indicating appropriate baseline comparability. These demographic trends are consistent with the findings of Rowhani-Rahbar et al. (2013), who reported similar mean age and gender distribution in their evaluation of post-vaccine adverse events in children[11]. The similarity in baseline characteristics supports the reliability of dermatological outcome comparisons across both vaccine types.

Regarding overall dermatological reactions, this study found a significantly higher frequency among children receiving live vaccines (60.00%) compared to those receiving inactivated vaccines (32.73%), with a p-value of 0.004. This observation is in agreement with findings by Miller et al. (2010), who noted that live vaccines such as MMR were more frequently associated with local and systemic skin reactions than inactivated formulations like DTP[12]. The higher reactivity of live vaccines may be due to their replication in host cells, which elicits a stronger immunogenic and inflammatory response.

Erythema was the most common dermatological reaction observed, occurring in 25.45% of children in the live vaccine group and 10.91% in the inactivated group (p=0.04). This aligns with the results of Sood et al. (2015), who reported erythema in 28.3% of pediatricsubjects post-measles vaccination, a commonly used live vaccine[13]. These data reinforce that erythema is a predictable cutaneous outcome of live vaccine administration due to localized immune activation at the injection site.

While swelling, rash, and induration were also more common in the live vaccine group, these differences did not reach statistical significance in this study. Interestingly, urticaria was observed only in the inactivated vaccine group (5.45%), although this was also not statistically significant (p=0.08). Similar findings were reported by Bohlke et al. (2003), who documented transient urticarial reactions predominantly following inactivated influenza vaccines in children[14]. This may reflect hypersensitivity responses to vaccine components such as adjuvants or preservatives used in inactivated formulations.

When evaluating severity, the majority of reactions in both groups were mild, with 60.61% of the live vaccine group and 77.78% of the inactivated group reporting mild symptoms. However, only the live vaccine group experienced severe reactions (6.06%). These findings are comparable to those of Baxter et al. (2012), who found that severe local reactions were rare but more commonly reported after live vaccines like varicella, suggesting the need for close post-vaccination monitoring in live vaccine recipients[15].

Although the overall safety profile of both vaccine types remains acceptable, the broader range and increased severity of dermatological reactions observed with live vaccines in this study highlight a difference in tolerability. This is consistent with the conclusion drawn by Chen et al. (1994), who emphasized that while live vaccines offer strong immunogenicity, they are also more likely to produce visible local or systemic adverse effects due to viral replication and immune mimicry[16]. These findings underscore the importance of informed parental counseling and robust post-vaccination surveillance, especially for live vaccine programs.

CONCLUSION

This study demonstrated that dermatological reactions were significantly more common in children receiving live vaccines compared to those receiving inactivated vaccines. Erythema was the most frequent reaction, particularly in the live vaccine group. Although most reactions were mild, severe reactions occurred only with live vaccines. These findings underscore the need for careful monitoring and counseling when administering live vaccines to pediatric populations.

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