

House Dust Mite Allergies Among Elementary Students in a Semi-Rural Area

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Abstract. Allergies represent a chronic health concern among schoolchildren in Indonesia. The disorder is increasing in number but often underdiagnosed, particularly in semi-rural areas facing limited access to health services. This community service sought to facilitate access to initial allergy screening and increase awareness of the allergic status of elementary schoolchildren in the semi-rural area of Muaragembong, Bekasi. Allergy screening was conducted using the Skin Prick Test (SPT) method to detect sensitization to house dust mite (HDM) allergens *Dermatophagoides pteronyssinus* (*Derp*) and *D. farinae* (*Derf*) in 98 participants aged 6–13 years. Subsequent data analysis and interpretation aimed to enhance health awareness. The results indicated that the total prevalence of HDM sensitization reached 24.5%, with 7.1% of them sensitized to both allergens. This finding highlights the critical nature of the allergy issue and the need for its proactive intervention. Direct discourse about this discovery with parents/guardians and local healthcare services is pivotal to raise their awareness. Future efforts should prioritize the development of HDM avoidance protocols that require active parental participation in routine household cleaning as a community-based solution. Additionally, establishing formal referral networks to local health facilities, governments, and other policymakers is essential for ensuring ongoing allergy management.



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INTRODUCTION

Allergic diseases are among the most ubiquitous noncommunicable chronic disorders affecting children worldwide. The recent International Study of Asthma and Allergies in Childhood (ISAAC) Phase III study reported prevalence rates of 14.1% for

asthma, 14.6% for allergic rhinitis, and 7.3% for eczema among children aged 13–14 years (Mallol et al., 2013). The atopic triad consists of three conditions that often coexist in the same individual, sharing common underlying immunological mechanisms. Recent epidemiological data indicate that children with allergic rhinitis have

substantial comorbidity with asthma (45.71%) and atopic dermatitis (50%), while children with atopic dermatitis demonstrate high burdens of atopic comorbidities, with 92.5% reporting at least one comorbid atopic condition (Rahman et al., 2025; Weidinger et al., 2024). This aligns with the atopic march theory, which posits a relationship among atopic dermatitis, asthma, and subsequently on allergic rhinitis (Schoos, 2024).

Among the primary causative allergens, house dust mites (HDM), particularly *Dermatophagoides pteronyssinus* (Derp) and *D. farinae* (Derf), represent the main indoor sensitizing agents. A recent 2025 systematic review highlights high aeroallergen sensitization across Asia, including Southeast Asia, with regional variations observed in the dominance of HDM, from lows of 10% to 20% in areas like India and Vietnam, to highs surpassing 85%–90% in locations such as Singapore and southern China (Yin et al., 2025). Specifically, research focused on the region reveals that Indonesia carries the highest detection rate for Derp, with both Derp and Derf detected at a high and similar frequency (97%), making HDM a critical local factor (Kim et al., 2024). This prolonged exposure will lead to progressive airway inflammation and disease progression toward allergic diseases.

The high prevalence of sensitization has consequences beyond immediate physical symptoms. Recent studies indicate that allergic diseases significantly impair children's educational trajectory; for instance, allergic rhinitis is strongly associated with sleep fragmentation and excessive daytime sleepiness, leading to impaired daily activities and school performance (Ablewi et al., 2024).

A critical challenge in managing this burden is that atopic conditions in children are often subclinical or "silent." Clinical assessment alone often fails to detect this subclinical disease, leading to high rates of underdiagnosis in pediatric populations (Martin et al., 2022). In lower- and middle-income countries, rapid urbanization has escalated allergic burdens through increased pollutant exposure and indoor allergens. While clinical manifestations may be lower

than in affluent nations, these populations often exhibit high sensitization rates without overt symptoms (Gupta & Mapondela, 2024). This discrepancy is highlighted by research showing that clinical tools like the ISAAC questionnaire may yield only about 60% accuracy compared to objective sensitization markers (Kim et al., 2018). Consequently, limitation of general, objective examination to identify these underlying conditions leads to the ongoing neglect of subclinical allergies, which may risk their progression.

Allergic disease is well-documented in urban populations; however, there are notable deficiencies in diagnosis and awareness within semi-rural and rural communities. A 2023 review of rural health disparities in the United States indicated that rural areas constitute over 60% of all primary care health professional shortage areas, resulting in substantial disparities in the recognition and management of allergic diseases. This absence of specialized services in rural regions resulted in numerous children with allergic conditions remain undiagnosed and untreated (Pongdee et al., 2024). In Indonesia, access to healthcare in semi-rural and remote areas is primarily hindered by structural inconsistencies, where the physical presence of primary healthcare facilities is often insufficient due to erratic functional capacity, inadequate human resources, and a lack of operational dependability. This physical barrier is exacerbated by low health literacy, as insufficient internet connectivity and limited digital skills hinder local communities from accessing modern health information and telemedicine, thereby worsening existing health disparities throughout the archipelago (Setianti et al., 2025). Such conditions may lead to underreporting and undiagnosed allergic cases in semi-rural areas of Indonesia, thereby hindering their proper treatment.

Muaragembong District, a semi-rural area in Bekasi, encounters similar challenges, including limited access to health facilities. This area currently has two public health centers, one pharmacy, and lacks a hospital (Indonesian Central Bureau of Statistics Bekasi Regency, 2025). This leads to additional challenges, including limited

access to allergists and specialized diagnostic equipment, insufficient training of primary healthcare workers in allergy recognition, a lack of community awareness regarding the symptoms of allergic diseases, and minimal integration of allergy screening into primary healthcare services.

Targeting children in elementary school is optimal because of the high prevalence and significant burden of allergic sensitization observed within this age group (Bunne et al., 2022). School-based health screening represents an evidence-based approach aligned with community health promotion principles. One of the simplest and most established methods for detecting allergies is the Skin Prick Test (SPT). This method provides characterization of allergic sensitization to indoor allergens, including HDM, with excellent accuracy and a safe or minimally invasive procedure (Tang et al., 2022).

The urgency for implementing objective screening methods, such as the SPT, is underscored by recent prevalence data from Indonesia, which demonstrate a substantial disease burden among school-aged populations. The 2023 Indonesian Health Survey (Survei Kesehatan Indonesia/SKI) indicates an asthma prevalence of 1.2% among individuals aged 5–14 year, highlighting the onset of the disease burden within the pediatric population (Ministry of Health of the Republic of Indonesia & Health Development Policy Agency, 2024). Concurrently, the prevalence of allergic rhinitis in Indonesia is estimated to range from 10% and 20%, with an average age of onset between 8 and 11 years. Additionally, the prevalence of atopic dermatitis is 23.67%, making it the most common skin diseases observed in Indonesian children (Al-Ihya et al., 2023; Balqis et al., 2025).

HDM sensitization plays a central role in atopic progression, with a 2025 review confirming that dust mites trigger allergic rhinitis, conjunctivitis, asthma, atopic dermatitis, and other allergic conditions, emphasizing the critical importance of early diagnosis for effective intervention (Han et al., 2025). Recent pediatric data indicate that children show significantly higher sensitization to *Derp* compared to adults (OR=0.343, 95% CI: 0.167–0.702, $p<0.01$),

highlighting the particular susceptibility of school-aged populations (Alberba et al., 2025).

The significant role of HDMs in allergy sensitization within semi-rural areas remains underexplored. This community service adopts a comprehensive approach by conducting skin prick testing for *Derp* and *Derf* sensitization, with the objective of enhancing public awareness about allergic disease recognition and evidence-based management. This generates both epidemiological data and direct benefits to the community by improving family health literacy. Implementing systematic screening and provision of individual results, coupled with targeted health education on HDM allergen avoidance, the project aims to enhance students and parental awareness regarding the allergic status of children and increase their recognition of allergic diseases. Moreover, this community service may facilitate family engagement with local primary health services for managing allergic diseases.

METHOD

This community service activity employs a participatory approach through allergy screening and increasing community awareness on allergies and respiratory disturbances among elementary students (grades 1-6). This activity was conducted from July to October 2025, consisting of three primary steps: preparation, implementation, and evaluation (Figure 1).

Preparation

The community service team from School of Medicine and Health Sciences, Atma Jaya Catholic University of Indonesia (SMHS AJCUI) coordinated with the headmaster and teachers from SDN Pantai Harapan Jaya 03 (PHJ03) school, located in Muaragembong, Bekasi Regency, West Java, Indonesia to establish activity schedules, obtain implementation permission, and prepare the Skin Prick Test (SPT) reagents and reading form for *Dermatophagoides pteronyssinus* (*Derp*) and *D. farinae* (*Derf*). The preparation was done between July to early October 2025 (Figure 2). This study has been approved by

Ethical Committee of SMHS AJCUI with referral no. 07/08/KEP-FKIKUAI/2025.

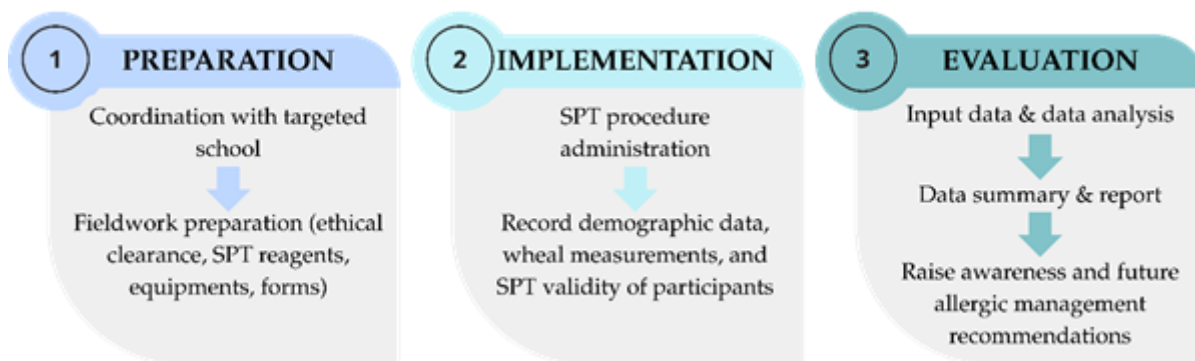


Figure 1. Community service flowchart; SPT: Skin Prick Test



Figure 2. Socialization and Program Discussion at SDN PHJ03: a) First socialization with the headmaster; b) Follow-up socialization with headmaster and teachers

Implementation of Skin Prick Test (SPT)

The SPT screening was conducted in the SDN PHJ03 area in late October 2025. The participants include elementary students aged 6–13 years old who were willing to be tested using the SPT method and have been given consent by their parents or guardians to participate in the study. Every participant was checked with SPT to detect any sensitization to two prevalent HDM species—*Derp* and *Derf*.

The SPT was performed by applying standardized Soluprick®-products allergen extracts of both HDM species (*Dermatophagoides pteronyssinus* 10,000 BU/mL and *Dermatophagoides farinae* 10,000 BU/mL) on the clean volar forearm of students' non-dominant hand, ensuring a spacing of ≥ 2 cm. This procedure included a positive control (10 mg/mL histamine dihydrochloride) and a negative control (diluent) (ALK-Abelló S.A., Madrid, Spain). Each drop was pricked with a disposable 1-mm, diagonal shoulders (DS) metal ALK lancet (ALK-Abello, S.A., Madrid, Spain)

for approximately 1 second without causing bleeding, and the results were interpreted after 15 minutes. During the reading process, any allergic reaction (swelling or wheal) observed on each student's hand was marked with a non-permanent marker and recorded with a clear tape. The SPT reaction was deemed valid when the negative control showed no wheal or the mean wheal diameter (calculated as the longest diameter plus the diameter perpendicular to it, divided by two) was < 3 mm, while the positive control displayed a wheal with a minimum diameter of 3 mm. The reaction to HDM allergen was classified as positive if the mean wheal diameter for either or both species was ≥ 3 mm (Heinzerling et al., 2013). The entire procedure is illustrated in Figure 3 and Figure 4.

Data Evaluation and Analysis

Data were analyzed descriptively and quantitatively, covering age distribution and the prevalence of HDM sensitization.

Participants with complete data and valid measurement will be included in the analysis. Gender-stratified descriptive analysis was also performed to compare sensitization patterns between boys and girls. After the completion of data analysis and interpretation, the results will be formally reported to the parents/guardians,

school representatives, the Muaragembong District Primary Health Center, and the Bekasi Regency Health Agency to provide scientific evidence of the existence of allergies in this area and the need for further strategies related to allergy diagnosis and treatment.

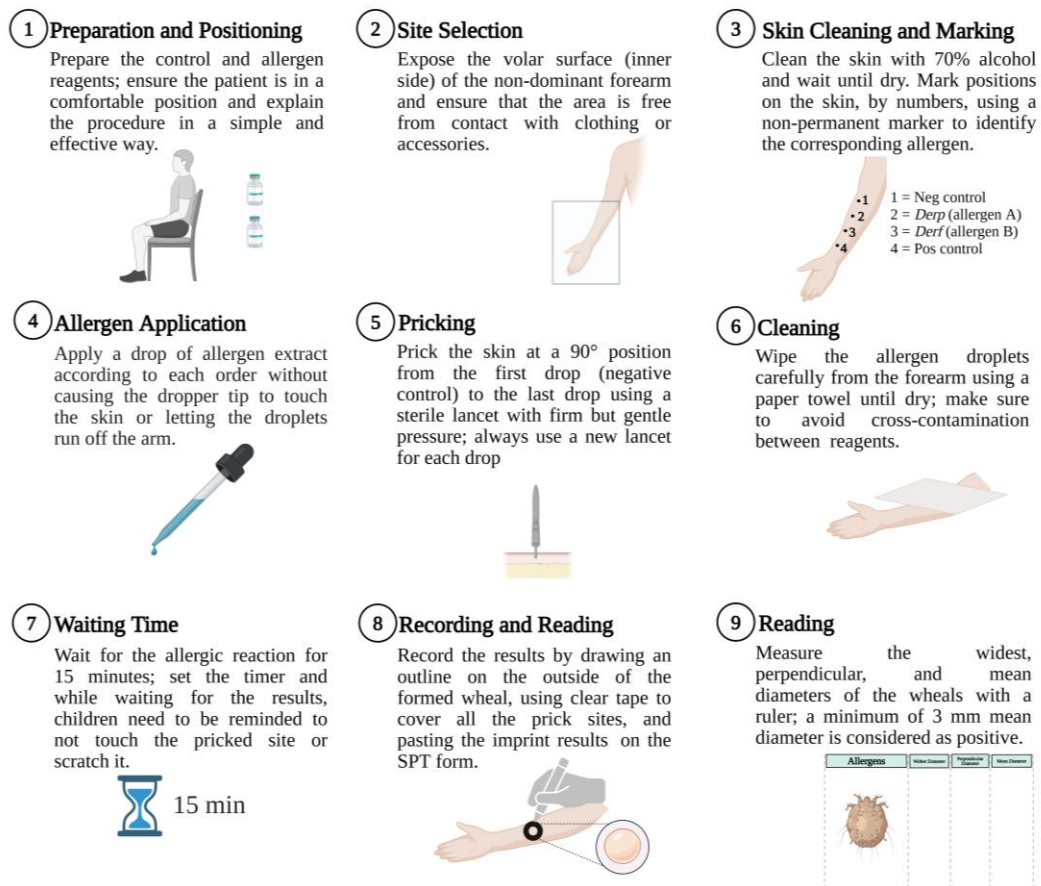


Figure 3. Skin Prick Test Procedure (Heinzerling et al., 2013); created using BioRender (<https://BioRender.com> with license)



Figure 4. The reading procedure of SPT: a) The wheal analysis, assisted by using lighting; b) The marking process of the wheal

RESULTS AND DISCUSSION

Among the 103 participants involved in the SPT analysis, 98 provided complete age data alongside valid SPT results. The mean age of the participants was 8.85 ± 1.896 years, with an age range spanning from 6 to 13 years. The student respondents consisted of 55 boys (53.4%) and 48 girls (46.6%). Categorically, the prevalence of sensitization to *Derp* was 13.6%, and sensitization to *Derf* was 16.5%. The overall prevalence of any HDM sensitization was 24.5% (Table 1).

Table 1. House Dust Mite Sensitization and Wheal Characteristics

Parameter	N	%
Sensitization Prevalence		
Any <i>Derp</i> -positive	14	13.6
Any <i>Derf</i> -positive	17	16.5
Any HDM sensitization	24	24.5
Mono- <i>Derp</i>	7	7.1
Mono- <i>Derf</i>	10	10.3
Poly-HDM	7	7.1
Not sensitized	74	75.5

Descriptive analysis by gender showed variation in prevalence: 15.7% of boys tested positive for HDM sensitization, whereas the prevalence among girls was higher at 34.0%. Furthermore, we analyzed the association between the student's age (based on school's grade classification) and HDM sensitization. HDM sensitization was identified among students across all grade levels, with the proportion of sensitized children ranged from 11.1% to 35.8% in grade 1–6. This finding supports the need for school-wide preventive and educational interventions rather than grade-specific approaches. The demographic analysis of this study may provide plausible contextual explanations based on observed patterns. For instance, sex-specific vulnerabilities to environmental factors (Rodriguez et al., 2022) or differences in activity patterns, hormonal variations, and

airway development (Jenkins et al., 2022; Wang et al., 2024) between males and females could contribute to the variations in allergic manifestations observed in the population.

We observed a co-sensitization rate of 7.1% (7/103), indicating that these participants exhibited positive reactions to both *D. pteronyssinus* and *D. farinae*. However, this simultaneous positivity likely reflects IgE cross-reactivity rather than independent primary sensitization. Therefore, the positive reactions observed for both species in our study should be interpreted as a manifestation of this high degree of molecular similarity.

This community service manages to screen and attain the sensitization profile to HDMs among school-aged children in a semi-rural area of Bekasi. The detected prevalence rate of 24.5% indicates that indoor allergen exposure is a relevant health concern in the said location. This data aligns with the global literature, which states that HDM are a major perennial allergen responsible for allergic rhinitis and asthma (Calderón et al., 2015). This prevalence data is notable when compared with other studies in Indonesia. A study in Tanjung Duren Utara, West Jakarta reported a 32.69% prevalence of HDM presence in homes, which was associated with high humidity and pet ownership (Majawati & Joselyn, 2019). Another study conducted on Flores Island showed variation in skin sensitization prevalence based on residential setting, with 13.5% in semi-urban areas and 8.5% in rural areas (Hamid et al., 2013). The higher prevalence in Muaragembong relative to semi-urban area in Flores may be influenced by environmental characteristics typical of Bekasi's coastal setting. The consistently high humidity in this region favors mite proliferation and survival (Charpin, 2021).

The relatively high prevalence of HDM sensitization in Muaragembong may further be explained by its semi-urban positioning. As a buffer zone bordering the capital, the area has undergone gradual environmental and lifestyle transitions toward urban-like characteristics. Such shifts are inevitable in regions experiencing ongoing urban expansion (Genovese et al., 2023); consequently, environmental factors commonly associated with urban settings may progressively extend into semi-rural zones and contribute to rising allergic sensitization. A

previous study in Indonesia has established a protective effect of helminth infections, due to poor sanitation, towards lower atopy rates in rural areas (Hamid et al., 2013). Therefore, it is assumed that the transition of Muaragembong towards an urbanized area likely involves improvements in sanitation and hygiene. Such environmental changes often lead to reduced exposure to immunomodulatory pathogens, thereby triggering hypersensitivity reaction and increasing the risk of allergic sensitization. Environmental pollutants also increase airway susceptibility to allergens. Combined with the coastal microclimate's high humidity, these factors create a "hybrid" environment that is highly conducive to allergic sensitization (Song et al., 2023).

The relatively high prevalence of HDM sensitization among elementary schoolchildren highlights the need for increased awareness and collaborative preventive efforts at the community level. The findings of this study will be communicated to the parents/guardians of the students, participating in school, the local health centers, and other policymakers to jointly strategize the following action and anticipation to control and eliminate pediatric allergy issues. Strengthening cooperation between schools and primary healthcare services may support early detection, environmental control, and appropriate referral for allergic conditions. Additional allergy-related education for parents and guardians is essential to improve prevention and daily management of HDM at home. Through education, parents and guardians might understand several measurements that could be done to avoid HDM allergens, which are doing regular cross ventilation, washing of bedding for a minimum of once a week using hot water, covering of mattresses with plastic, etc. (Aggarwal & Senthilkumaran, 2023). In particular, regular, interactive educational sessions for older students (grades 4–6) regarding allergies and personal hygiene may be conducted as an effective school-based preventive strategy. These plans are crucial to reducing the burden of pediatric atopic disease, thereby improving their quality of life and ensuring their optimal growth and development.

CONCLUSION AND SUGGESTION

This community service successfully conducted SPT screening for HDM sensitization, particularly *Derp* and *Derf*, among elementary schoolchildren in Muaragembong, Bekasi. The key substantive finding confirms the high prevalence of HDM sensitization, observed in 24.5% of participants, highlighting indoor allergen exposure as a major, yet often undiagnosed, health concern in this semi-rural community. This prevalence underscores the critical necessity for targeted intervention, particularly considering the recognized role of HDM as a primary trigger for pediatric atopic diseases. Furthermore, the findings in this program could help to provide health awareness to the participants and public. Based on these outcomes, it is strongly recommended that future community engagement activities focus on four key areas: developing and implementing low-cost, feasible HDM avoidance protocols tailored to the humid environment that rely on active parental participation in routine household cleaning and hygiene; establishing formal referral linkages with local primary healthcare centers to ensure children identified with sensitization receive continuous clinical management for their atopic symptoms; providing socialization and education regarding atopic diseases and its treatment or control to parents, guardians, and students to manage HDM and allergic manifestation in indoor settings; and empowering local school and community figures to become allergy health cadres to ensure the sustained and independent maintenance of awareness and early intervention efforts.

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