

Health Education for Bed Bug Control Among Islamic Boarding School Students in Semarang City

Martini Martini*, Mateus Sakundarno Adi, Nissa Kusariana, Ari Udiyono, Muh Fauzi

Faculty of Public Health, Universitas Diponegoro, Semarang, Indonesia

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Abstract Bed bugs (*Cimex* spp.), locally known as tinggi, kepinding, or tumbila, are blood-sucking insects that inhabit dark, damp areas, including mattresses and sofas. The two main species are *Cimex lectularius* and *Cimex hemipterus*, with *C. hemipterus* being common in tropical regions, including Indonesia. Although their prevalence previously declined, bed bug infestations have re-emerged in recent decades, largely due to increased mobility of people and goods. This activity was conducted at the At-Taqwa Orphanage in Semarang City to improve students' knowledge of bed bugs and their control through health education. This community service activity used a one-group pre-test and post-test design and involved 22 participants. The activities included a pre-test, an interactive education session, and a post-test. The results showed that most participants were unaware of bed bugs or their presence before the intervention. After the educational session, participants demonstrated a significant increase in knowledge and awareness. In addition to improving knowledge, this activity produced a positive outcome by strengthening participants' awareness and their ability to independently implement bed bug prevention measures in their living environment. Health education was effective as a preventive strategy, and similar programs should be implemented regularly to improve environmental hygiene and overall public health quality.

1. INTRODUCTION

Bed bugs (*Cimex* spp.) are hematophagous, ectoparasitic insects that are primarily nocturnal and rely on human blood as their principal source of nutrition. In local terminology, these insects are known by various names, including tinggi (Javanese), kepinding, and tumbila (Sundanese). The two main bed bug species known to infest humans are *Cimex lectularius*, which is commonly found in subtropical and temperate regions such as Europe and North America, and *Cimex hemipterus*, which is more prevalent in tropical regions, including Southeast Asia and Indonesia (Akhoundi et al., 2023; How & Lee, 2010; Meisyara et al., 2023).

In Indonesia, information on the prevalence of bed bug infestations remains relatively limited and is likely underreported. Nevertheless, a national online survey conducted by Meisyara et al. (2023), involving 600 respondents from several major cities in Indonesia, found that 60.3% of respondents had experienced bed bug infestations at least once, with 74.1% of cases occurring in

household settings. Furthermore, 34.0% of respondents reported infestations more than five times, indicating that bed bug problems in Indonesia are recurrent and potentially more widespread than official records suggest (Meisyara et al., 2023). In addition, a study conducted in several Islamic boarding schools in Palangka Raya identified the presence of *Cimex* spp. in 33.3% of the locations examined (Putri, 2023). Together, these findings indicate that bed bug infestations remain an important environmental health issue in Indonesia, particularly in urban areas with high population mobility, and they highlight the need for community-based education and prevention efforts to reduce infestation risks and associated health impacts.

Bed bugs commonly hide in dark, humid sites such as mattresses, cracks in furniture, pillow folds, and areas behind wood and rubber materials. They emerge at night to feed on the blood of sleeping humans, and their bites may cause allergic reactions, pruritus, sleep disturbances, and

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*Corresponding author: Martini

Faculty of Public Health, Jl. Prof. Jacob Rais, Tembalang, Semarang, Jawa Tengah, 50275, Indonesia

Email: martini@live.undip.ac.id

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reduced quality of life. Children and women have been reported to be at higher risk of being bitten, which may be related to differences in skin thickness or variation in individual sensitivity. One distinctive characteristic of bed bugs is the pungent odor released when they are crushed, a feature that is often noted in community descriptions of these insects (Deku et al., 2022; Kawasima et al., 2022; Khan & Rahman, 2012; Rajonhson et al., 2022).

In Indonesia, bed bugs were commonly reported in residential houses, cinemas, hotels, lodgings, and other places where people sleep or sit until the late 1970s. During the 1980s, bed bugs were frequently reported in buildings such as dormitories, campuses, and residential settings, not only in Indonesia but also in developed countries, including the United States, Canada, several European countries, and Australia, as well as in Malaysia and Singapore (Harlan, 2016). In 2007, a bed bug outbreak was reported across all 50 states in the United States. In Indonesia, surveys on bed bug presence were conducted in Gebang Village, Sragen, Central Java, in 2010, as well as in the preparatory dormitories of IPB University in 2010 and 2015. Additionally, in 2017, surveys were carried out in tourist areas and residential settlements in Manado and the Sitaro Islands, North Sulawesi (Alizadeh et al., 2020).

The global resurgence of bed bug infestations has become a continuing challenge in medical entomology. This phenomenon has been linked to increased mobility of people and goods associated with globalization, the development of resistance to certain insecticides, and limited public awareness regarding the identification and control of these pests. From a public health perspective, health promotion approaches play an important role in controlling bed bug infestations. According to the health determinant model proposed by H. L. Blum, individual behavior is a dominant factor influencing health status, alongside genetic, environmental, and health service factors. Hygienic practices and awareness of household and residential environmental cleanliness are therefore essential for preventing the spread of bed bugs (Noviasari, 2021).

Tembalang District has approximately 35 orphanages and Islamic boarding schools. Among these institutions, two locations were identified as having a potential risk of bed bug infestation. Residents in these locations experienced symptoms consistent with bed bug bites, including itching and skin rashes, sleep disturbances related to nocturnal biting, and several cases of skin infections. Most residents were unaware of the presence of bed bugs before the preliminary survey, and hygiene conditions in some locations were inadequate, including suboptimal management of beds, sheets, and linens. Therefore, a program focusing on the identification, prevention, and control of bed bugs is needed in orphanages and Islamic boarding schools in Tembalang District. The selected site for this activity was At-Taqwa Orphanage, located in Meteseh, Tembalang, Semarang, Indonesia.

Based on the preliminary survey, which indicated the continued presence of bed bug infestations in densely populated residential environments such as orphanages

and Islamic boarding schools, educational interventions are needed to improve community awareness, particularly among students, regarding the risks and prevention of bed bug infestations. This study aimed to evaluate the effectiveness of a health education program in increasing students' knowledge and awareness of bed bug control.

2. METHOD

Bed bug infestations can disrupt the comfort and health of orphanage residents. Therefore, this activity aimed to improve residents' understanding and skills in independently identifying and controlling bed bugs.

Implementing Team:

- Supervising lecturer (community service lead): planned and implemented the activity and conducted monitoring and evaluation.
- Students: supported module development, collected data, facilitated participants during practical sessions, documented activities, and prepared the final report.
- Partner institution (At-Taqwa Orphanage): provided the venue and coordinated participant recruitment.
- Orphanage administrators and residents: participated in the education and mentoring sessions as the target group.

This community service activity was conducted over three days, from 20 to 22 July 2024. On the first day, the activity began with orientation and coordination with the partner institution and lasted approximately two hours. The second day focused on the implementation of educational and training activities for orphanage residents, with a total duration of four hours. The materials were delivered through interactive lectures, guided discussions, and field-based practical sessions on bed bug identification, prevention, and control. On the third day, the activity was evaluated, followed by joint reflection with participants and formulation of follow-up actions, with an allocated duration of three hours. This series of activities was designed to equip participants with the knowledge and practical skills needed to independently and sustainably identify and control bed bugs.

2.1 Data collection techniques

a. Sampling technique

Purposive sampling was used to select participants based on active involvement in daily orphanage activities and exposure to bed bug infestation risk, for example, residents living in densely occupied sleeping areas. The sample comprised approximately 25 participants, including residents aged ≥ 12 years and orphanage staff.

b. Data collection instruments

Pre-test and post-test assessments were administered using a structured questionnaire consisting of 10 multiple-choice items related to knowledge and

attitudes toward bed bugs. Direct observations were conducted during practical sessions that included identification activities and simulation of preventive measures. An observation checklist was developed using indicators of participants' ability to recognize signs of infestation, detect bed bugs, and communicate relevant information about bed bug prevention and control.

c. Instrument validity and reliability

Content validity was assessed through expert judgment by two lecturers specializing in entomology and environmental health. Reliability testing was conducted through a pilot trial with a small group before the main activity, and Cronbach's alpha coefficient was >0.70 , indicating acceptable internal consistency.

2.2 Data analysis

Pre-test and post-test data were analyzed using descriptive quantitative methods, including calculation of mean scores and the percentage increase in knowledge. A comparative test, either a paired t-test or a Wilcoxon signed-rank test depending on the data distribution, was performed to determine the statistical significance of outcome improvements. Qualitative data from observations and discussions were analyzed using thematic analysis to describe participants' understanding, engagement, and responses to the activity.

3. RESULT AND DISCUSSION

This community service activity was attended by 22 participants who were residents of At-Taqwa Orphanage in Meteseh, Tembalang, Semarang, Indonesia (Figure 1). Before the educational materials were delivered, a pre-test was administered to assess participants' baseline knowledge regarding bed bugs, including their characteristics, routes of spread within sleeping environments, health impacts, and prevention measures.

The pre-test results (Table 1) indicated that some participants already had basic knowledge of general bed bug characteristics, including that bed bugs feed on blood (81.8% correct) and are active at night and bite during

nighttime hours (81.8% correct). This pattern may be related to participants' direct experiences living in densely populated settings with an elevated risk of bed bug infestation. However, a substantial misconception was identified in specific content areas, particularly regarding the cause of itching following bed bug bites, with 100% of participants answering this question incorrectly. These responses indicate misunderstanding of the physiological mechanism underlying the body's reaction to bed bug bites, which is primarily triggered by allergenic proteins in bed bug saliva rather than by feces or external contamination. This misconception requires targeted correction because it may lead to inappropriate symptom management practices among participants.

In addition to knowledge gains, participant satisfaction with the implementation of the activity served as an important indicator in evaluating the community service program. Based on the post-activity questionnaire, most participants reported satisfaction with the materials delivered, the educational methods used, and the opportunities provided for hands-on practice. Participants perceived the materials as easy to understand and relevant to the conditions of their living environment. The high level of satisfaction suggests that the educational program was responsive to participants' needs and was positively received by the target community.

From the perspective of program sustainability, post-activity discussions and field observations indicated increased participant self-efficacy related to personal hygiene practices and independent prevention of bed bug infestations. This was reflected in participants' stated willingness to adopt routines such as regularly sun-drying mattresses, maintaining cleanliness in sleeping areas, and conducting periodic inspections of their sleeping environment. In addition, several orphanage administrators expressed commitment to sustaining these hygiene practices and disseminating the information to other residents. These findings indicate that health education not only produced short-term improvements in knowledge but also has potential to support sustained behavioral change aimed at controlling bed bug infestations in the orphanage environment.

The paired-samples t-test showed that the mean

Table 1 . Pre-test results (n = 22)

Questions	Answers (%)	
	Pre-Test (Correct)	Post-Test (Correct)
Bed bugs feed on blood	81.8	95.5
The characteristics of bed bugs include a white color and oval shape	72.7	95.5
Adult bed bugs are active and bite at night	81.8	90.9
Itching and redness after bed bug bites are caused by contamination from feces	0	4.5
The simplest way to prevent bed bugs is by sun-drying and routinely cleaning mattresses	86.4	100
Bed bugs can move from one place to another	86.4	100
Bathing at least twice a day can prevent bed bug bites	81.8	81.8
Bed bug bites can cause death	86.4	100
Bed bugs can be eliminated using insecticides	86.4	100
Damp mattresses/rooms can become breeding sites for bed bugs	100	100



Figure 1 . Implementation of the educational activity for the target group

knowledge score before the health education session was 7.64 and increased to 8.68 after the session. The paired-samples t-test yielded a p-value of 0.0002 ($p < \alpha$), indicating that the health education intervention on bed bug control significantly improved participants' knowledge regarding bed bugs and their control.

However, closer examination of the item-level distribution showed that for one specific item (Question 7), the proportion of correct responses remained unchanged between the pre-test and post-test. This result suggests that the educational intervention did not sufficiently address this topic, or that the material related to this question was not optimally understood by participants during a single session.

These findings indicate that while the intervention improved overall knowledge, certain components of bed bug control require more focused and reinforced educational strategies. Therefore, future programs should prioritize topics that remain poorly understood, particularly those reflected by unchanged correct response rates, through repeated education sessions, strengthened visual teaching aids, or more intensive practical demonstrations.

Table 2 . Results of paired-sample t-test

	Mean	Std. Deviation	Std. Error Mean	P-Value
Pre-Test	7.64	1.136	0.242	0.0002
Post Test	8.68	0.477	0.102	

Table 2 presents the results of the paired-samples t-test used to compare mean knowledge scores before and after the health education activity. The mean pre-test score was 7.64, with a standard deviation of 1.136 and a standard error of 0.242. After the activity, the mean score increased to 8.68, with a standard deviation of 0.477 and a standard error of 0.102. The analysis indicated a statistically significant difference between pre-test and post-test scores, with a p-value of 0.0002, demonstrating that the health education activity had a significant effect on improving participants' knowledge.

The educational approach used in this activity, active lectures combined with discussions and field-based practical sessions, was effective in improving participants' knowledge. This finding aligns with active learning theory,

which emphasizes the role of direct participant engagement in the learning process (Basten & Jannah, 2024). When participants took part in hands-on activities to identify bed bugs and their harborages, they not only received information but also developed applied competencies and practical skills that can be implemented in daily life. This approach is important given the diversity of participants' educational backgrounds and ages, because visual and practical methods are typically more accessible than one-way instructional delivery.

Furthermore, the pre-test and post-test instruments not only measured changes in knowledge but also served as reflective tools to identify material requiring additional reinforcement. For example, despite improvements in most indicators, the item addressing the cause of itching after bed bug bites was still answered incorrectly by most participants, with only 4.5% providing the correct response in the post-test. This finding indicates that not all content can be effectively absorbed in a single educational session and highlights the need for repetition or reinforcement through additional media, including posters, educational videos, or illustrated modules that are accessible and easily understood by children.

4. CONCLUSION

The educational activity on bed bug control conducted at At-Taqwa Orphanage resulted in a significant improvement in participants' knowledge. This outcome was demonstrated by an increase in the mean knowledge score from 7.64 to 8.68 ($p = 0.0002$). The educational approach, which combined interactive lectures, discussions, and hands-on practice, was effective in delivering relevant and applicable information to participants. However, several misconceptions were not fully corrected, indicating the need to reinforce key messages through supporting educational media or follow-up sessions. Overall, this activity indicates that community-based health education interventions can be an effective strategy for strengthening community capacity, particularly among vulnerable groups, to independently and sustainably recognize and control bed bug infestations.

This community service program also had a positive impact by increasing participants' awareness and their ability to recognize signs and symptoms associated with bed bug infestations, as well as to independently implement simple preventive measures, including maintaining cleanliness of sleeping areas and the broader residential environment. The benefits were also evident at the institutional level because orphanage administrators gained practical knowledge that can be used as a reference for sustained management of environmental hygiene within the orphanage. The observed increase in participants' self-efficacy related to self-care and bed bug control suggests that this intervention not only produced short-term improvements in knowledge but also has potential to promote sustained health behavior changes. Therefore, community-based health education can be considered an effective promotive and preventive strategy for improving

environmental health quality and the overall well-being of orphanage residents as a vulnerable population.

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CONFLICT OF INTERESTS

The authors declare that there is no conflict of interest regarding the publication of this article.

REFERENCES

- Akhoundi, M., Zumelzu, C., Sereno, D., Marteau, A., Brun, S., Jan, J., & Izri, A. (2023). Bed bugs (Hemiptera: Cimicidae): A global challenge for public health and control management. *Diagnostics*, *13*(13). <https://doi.org/10.3390/diagnostics13132281>
- Alizadeh, I., Jahanifard, E., Sharififard, M., & Saki-Malehi, A. (2020). Spatial distribution of bedbug infestation in infested houses: Is there an association between sanitation of houses and bedbug presence? *Journal of Environmental Health and Sustainable Development*, *5*(2), 985-992. <https://doi.org/10.18502/jehsd.v5i2.3385>
- Basten, H. L. van, & Jannah, N. (2024). Penggunaan model active learning dalam meningkatkan motivasi siswa di era digital pada pembelajaran Fiqih di Samakkee Islam Wittaya School Thailand. *Jurnal Pendidikan dan Pembelajaran Indonesia (JPPI)*, *4*(2), 770-783. <https://doi.org/10.53299/jppi.v4i2.618>
- Deku, G., Combey, R., & Doggett, S. L. (2022). Morphometrics of the tropical bed bug (Hemiptera: Cimicidae) from Cape Coast, Ghana. *Journal of Medical Entomology*, *59*(5), 1534-1547. <https://doi.org/10.1093/jme/tjac072>
- Harlan, H. J. (2016). Bed bugs 101: The basics of *Cimex lectularius*. *American Entomologist*, *52*(2), 99-101. <https://doi.org/10.1093/ae/52.2.99>
- How, Y., & Lee, C. (2010). Survey of bed bugs in infested premises in Malaysia and Singapore. *Journal of Vector Ecology*, *35*(1), 89-94. <https://pubmed.ncbi.nlm.nih.gov/20618653/>
- Kawasima, E. S., de Paiva, V. F., Belintani, T., Garcia Justino, H. H., Nascimento, J. D., Pinotti, H., de Oliveira, J., & da Rosa, J. A. (2022). Morphological studies of *Cimex lectularius* Linnaeus, 1758 (Hemiptera: Cimicidae). *Revista Chilena de Entomología*, *48*(4), 695-705. <https://doi.org/10.35249/rche.48.4.22.01>
- Khan, H. R., & Rahman, M. M. (2012). Morphology and biology of the bed bug, *Cimex hemipterus* (Hemiptera: Cimicidae) in the laboratory. *Dhaka University Journal of Biological Sciences*, *21*(2), 125-130. <https://doi.org/10.3329/dujbs.v21i2.11510>
- Meisyara, D., Guswenrivo, I., & Singham, G. V. (2023). Perception, attitudes, and knowledge on infestation and management of bed bugs in major cities of Indonesia: A cross-sectional online survey. *PLOS ONE*, *18*(7), e0288682. <https://doi.org/10.1371/journal.pone.0288682>
- Noviasari, N. A. (2021). Analysis of risk factors H. L. Blum in hypertension patients. *International Journal of Health, Education and Social (IJHES)*, *2*(4), 1-15. <https://ijhes.com/index.php/ijhes/article/view/139>
- Putri, E. W., Widiarty, A., & Jabal, A. R. (2025). Identifikasi dan distribusi kutu busuk (*Cimex* sp.) di beberapa pesantren Kota Palangka Raya. *Media Kesehatan Politeknik Kesehatan Makassar*, *20*(1), 125-130. <https://doi.org/10.32382/medkes.v20i1.1239>
- Rajonhson, D. M., Raksakoon, C., Payakkapol, A., Dujardin, S., Dujardin, J., & Potiwat, R. (2022). Comparison of two different morphological methods to study the pronotum of Cimicidae: Bed bugs, bat bugs, and swallow bugs. *Insects*, *13*(12). <https://doi.org/10.3390/insects13121155>