Education on Ari Risk Mitigation Caused by Environmental Mold and Waste Management in The Community of Tembok Dukuh Sub-District, Bubutan District, Surabaya

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ABSTRACT

Background: Acute Respiratory Infection (ARI) is the disease with the highest number of cases in Indonesia, with one of the often-overlooked environmental risk factors being mold growth caused by indoor humidity and poor waste management. **Objective:** This community service activity aimed to improve public knowledge and awareness regarding the relationship between environmental mold, waste management, and the risk of ARI, as well as to encourage the implementation of clean and healthy living behavior (PHBS). **Methods:** The activity was conducted on Saturday, 23 April 2026, from 07:45 to 10:00 WIB at Tembok Dukuh X Balai RT 12 RW 01, Tembok Dukuh Sub-district, Bubutan District, Surabaya, targeting 25 residents. The implementation method consisted of a pretest, education and outreach, interactive discussion, a waste management demonstration, and a posttest as the evaluation instrument using an 8-item multiple-choice questionnaire. **Results:** The results showed an increase in the participants' average knowledge score from 6.88 (median 7; range 4–8) at pretest to 7.69 (median 8; range 7–8) at posttest, accompanied by a narrowing score range indicating more even understanding among participants. **Conclusion:** This activity proved effective in improving community knowledge regarding ARI risk mitigation due to environmental mold and waste management, and is expected to be applied sustainably in daily life.

Keywords: ARI, environmental mold, waste management, health education, clean and healthy living behavior

INTRODUCTION

Acute Respiratory Infection (ARI) is one of the major public health problems in Indonesia, with an extremely high number of cases. The World Health Organization defines acute respiratory infection (ARI) as a viral infection affecting the upper or lower respiratory tract, with severity varying according to the pathogen, host immunity, and environmental factors[10]. The infection often starts in the upper respiratory tract before spreading to the lower respiratory tract[12]. In developing countries, lower ARI accounts for 25–50% of morbidity and mortality, with even higher rates in densely populated areas[11]. Based on data from the Ministry of Health of the Republic of Indonesia in 2025, ARI ranks first as the disease with the highest number of cases, reaching 10,514,717 cases, far surpassing other diseases such as acute diarrhea and Influenza Like Illness (ILI)[1]. This is also consistent with global trends, in which the World Health Organization reports that ARI remains one of the highest burdens of infectious disease across many countries, including developing nations[7]. The distribution of ARI cases also shows high numbers across various provinces, particularly in densely populated areas, with West Java recording the highest number of cases at 1,787,725, followed by Central Java at 1,620,566, and East Java at 958,217[1]. These high figures indicate that environmental factors and residential density play an important role in increasing the risk of ARI.

One environmental factor that is often overlooked is the growth of mold indoors. Mold can proliferate rapidly in humid environments with minimal lighting and poor air circulation. Damp environments provide favorable conditions for mold growth, allowing it to spread and establish colonies on surfaces including walls, ceilings, and furniture[9]. Mold spores inhaled by residents can potentially cause various health problems, such as allergic reactions, respiratory tract irritation, and infections, particularly in individuals with low immune systems. A long-term cohort study by Maaranen et al. (2025) involving more than 2,500 participants from pregnancy through age 27 showed that exposure to dampness and mold in residential environments consistently increased the risk of upper and lower respiratory tract infections, with an exposure-response pattern in which risk increased with the duration of exposure[2]. The incidence trend of ARI also shows an increase during the rainy season, marked by lower temperatures and higher humidity that support the growth of microorganisms in the environment.

On the other hand, poor waste management systems also contribute to an increased risk of ARI. The accumulation of waste, particularly organic waste, can create a dirty, damp environment with unpleasant odors, thereby becoming a breeding ground for microorganisms including mold and bacteria that can potentially degrade air quality. The study by de Titto and

Savino (2024) affirms that inadequate solid waste management contributes to air pollution and increased respiratory disorders in communities surrounding waste accumulation areas[3]. Furthermore, a review by Eshete, Desalegn, and Tigu (2023) showed that although community knowledge regarding household waste management is generally considered good, waste management practices in the field remain poor, making the gap between knowledge and actual practice one of the main challenges in efforts to prevent environment-based diseases[4]. The lack of community knowledge regarding the importance of environmental cleanliness, humidity control indoors, and proper waste management is one of the causes of the still-high ARI risk factors in residential environments.

This problem was also identified in the Tembok Dukuh X Balai RT 12 RW 01 area, Bubutan District, Surabaya, which is a densely populated area with the potential for humidity issues and suboptimal waste management. Experience from similar educational activities shows that direct education on ARI prevention measures can significantly improve community knowledge.[5] Based on these issues, educational activities on ARI risk mitigation due to environmental mold and waste management in the community were deemed necessary. This activity aims to improve community awareness and understanding of the risk of ARI caused by mold spore exposure, as well as to encourage the implementation of clean and healthy living behavior (PHBS) through optimal management of residential environments and waste.

METHODS

Activity Design

This activity used a pre-experimental design with a one-group pretest-posttest design, which is a design that measures participants' level of knowledge before (pretest) and after (posttest) an educational intervention is given to the same group, without a comparison (control) group. This approach is descriptive quantitative in nature, used to assess the effectiveness of the educational intervention through a comparison of participants' knowledge scores before and after the treatment. In addition to quantitative measurement through a questionnaire, the activity was also supported by direct observation of participants' responses, participation, and enthusiasm during the education, discussion, and demonstration processes.

Population and Sample

The population of this activity consisted of all residents domiciled in the Tembok Dukuh X Balai RT 12 RW 01 area, Tembok Dukuh Sub-district, Bubutan District, Surabaya. Sampling was conducted using a purposive sampling technique, namely the selection of

participants based on willingness and conformity with the predetermined criteria, resulting in a sample of 25 individuals who participated in the entire series of activities.

Inclusion and Exclusion Criteria

The inclusion criteria for participants in this activity were as follows:

- Residents domiciled in the Tembok Dukuh X Balai RT 12 RW 01 area, Bubutan District, Surabaya.
- Willing to participate and follow the educational activities from start to finish voluntarily.
- Willing to complete the pretest and posttest questionnaires in full.
- Aged at least 17 years or considered capable of understanding and completing the questionnaire independently.
- In good health and able to participate actively in the activity at the time of implementation.

The exclusion criteria for this activity were as follows:

- Participants who did not complete the entire series of activities (i.e., did not complete the pretest and/or posttest).
- Participants who withdrew before the activity was completed.
- Participants who completed the questionnaire incompletely or not in accordance with the filling instructions, making their data unsuitable for analysis.
- Participants who had limitations in reading or writing, making it impossible for them to complete the questionnaire independently without special assistance.

Location and Time of Activity

This community service activity was held on Saturday, 23 April 2026, from 07:45 to 10:00 WIB, at Tembok Dukuh X Balai RT 12 RW 01, Tembok Dukuh Sub-district, Bubutan District, Surabaya.

Target Participants

The target of the activity was community residents of the Tembok Dukuh X Balai RT 12 RW 01 area who were willing to participate in the entire series of educational activities from start to finish, with a total of 25 participants.

Activity Stages

The implementation of the activity was divided into several stages as follows:

- Preparation, including the development of educational materials, creation of educational media (posters and leaflets), coordination of permits with the RT/RW chairpersons, site survey, and development of evaluation instruments in the form of pretest and posttest questionnaires.

- Pretest, namely the completion of the initial questionnaire by participants to measure the level of knowledge prior to the educational delivery.
- Education and outreach, including the delivery of material on the definition of ARI, the relationship between environmental mold and ARI risk, methods of preventing mold growth, and proper waste management.
- Interactive discussion, in the form of a question-and-answer session between the presenter and participants regarding the material that had been delivered.
- Demonstration, in the form of a simple practice on how to maintain environmental cleanliness, prevent mold, and sort organic and inorganic waste.
- Posttest, namely the completion of the final questionnaire to measure the increase in participants' knowledge after the education.
- Distribution of healthy kits, in the form of the distribution of masks and cleaning tools as a form of support for the implementation of PHBS.

Event Schedule

The activity was held on 23 April 2026 from 07:45 to 10:00 WIB, beginning with committee preparations and an implementation briefing. This was followed by participant registration, distribution of refreshments, the opening ceremony, and the completion of the pretest questionnaire. The main session, consisting of education on ARI risk mitigation due to environmental mold and waste management, was conducted for 30 minutes, followed by an interactive discussion and question-and-answer session. Participants then received healthy kits, completed the posttest, attended the closing ceremony, and participated in a group photograph with the entire implementation team.

Instrument and Measurement (Pretest-Posttest)

Knowledge variable measurement was conducted using the same questionnaire instrument at the pretest and posttest stages, consisting of 8 multiple-choice questions on the definition of ARI, ARI symptoms, environmental conditions that support mold growth, the dangers of mold spores, and ARI risk factors from the environment. Each correct answer was given a score of 1 and each incorrect answer a score of 0, so that the total score ranged from 0 to 8 points per participant.

The pretest was completed by participants prior to the delivery of educational material to measure baseline knowledge, while the posttest was completed after the entire series of education, discussion, and demonstration had been carried out, so that the difference between pretest and posttest scores could be used as an indicator of the effectiveness of the educational intervention provided. Pretest and posttest data were subsequently analyzed descriptively by

calculating the mean, median, and range of scores, then compared to determine whether there was any improvement in participants' knowledge following the intervention.

RESULTS AND DISCUSSION

Participant Characteristics

The educational activity on ARI risk mitigation due to environmental mold and waste management was attended by 25 participants who were residents of RT 12 RW 01, Tembok Dukuh Sub-district, Bubutan District, Surabaya. All participants followed the entire series of activities from start to finish, including completing the pretest and posttest, so that all data could be analyzed.

Pretest and Posttest Results

Evaluation of participants' level of knowledge was conducted using a questionnaire administered before the education (pretest) and after the education (posttest). The questionnaire consisted of eight multiple-choice questions on ARI, environmental mold, and waste management. At pretest, the average participant score was 6.88 out of a total score of 8, with a median of 7 and a score range of 4–8. These results indicated that most participants already possessed a fairly good initial level of knowledge, although variation in understanding among participants remained.

Following the provision of education, interactive discussion, and a waste management demonstration, the average posttest score increased to 7.69 with a median of 8. The posttest score range also narrowed to 7–8, compared to the pretest score range of 4–8. All participants achieved high-category scores on the posttest. The increase in average score and narrowing of the score range indicate that the educational activity not only improved participants' knowledge in general, but also helped to equalize the understanding of participants whose knowledge had previously varied.

Overall, the evaluation results indicate that education on ARI risk mitigation due to environmental mold and waste management was effective in improving community understanding of environmental risk factors and preventive measures that can be applied in daily life.

Activity Budget Realization

The implementation of the activity was supported by a total budget of Rp745,000. The budget was used to print 25 questionnaire sheets at a cost of Rp25,000, provide participant refreshments at Rp250,000, procure healthy kits consisting of masks, small tissues, and hand sanitizer at Rp275,000, rent a projector at Rp150,000, and purchase mineral water at Rp45,000.

All of these requirements were used to support the smooth running of the educational activities and to increase participant engagement throughout the event.

Discussion

The results of the activity showed an increase in participants' average knowledge score from 6.88 to 7.69 (out of a total of 8 points), accompanied by an increase in median from 7 to 8 and a narrowing of the score range from 4–8 to 7–8. These findings consistently demonstrate that the educational intervention provided was effective in improving participants' knowledge, both at the group average level and individually, as all participants ultimately achieved high-category scores (≥7 out of 8 points) after the posttest, whereas at pretest a number of participants were still found to have low scores.

This improvement in knowledge is in line with the general principles of health promotion, in which knowledge is the cognitive domain that forms the basis for the development of a person's attitudes and actions. The pattern of knowledge score improvement through a one-group pretest-posttest design in this activity is also consistent with the findings of similar studies, such as those on the evaluation of the effectiveness of health education among students in Wamena, which also showed a significant increase in knowledge scores following a direct educational intervention. In the context of this activity, the direct educational method combined with interactive discussion and a demonstration of waste management practices provided a more concrete learning experience compared to one-way information delivery. The active involvement of participants in the question-and-answer session, in which participants raised questions related to how to clean mold at home and manage household waste, further strengthened the process of internalizing the information delivered, thereby contributing to the improvement in knowledge retention reflected in the posttest results[6].

The narrowing of the score range from pretest to posttest also indicates an equalization of understanding among participants. At the pretest stage, the fairly wide score variation indicated a gap in initial knowledge among participants, which was likely influenced by differences in educational background, age, and prior exposure to health information. After the education was provided, this gap narrowed significantly, indicating that the group education method was able to reach participants with varying initial levels of knowledge in a relatively even manner[7].

In terms of substance, the material delivered emphasized the link between environmental humidity, mold growth, waste management, and the risk of ARI. Humid environments with minimal air circulation, often exacerbated by the accumulation of organic waste, create optimal conditions for the growth of mold and other microorganisms. This is in

line with the cohort study by Maaranen et al. (2025) from the Espoo Cohort Study, which followed more than 2,500 participants from pregnancy through age 27 and showed that exposure to dampness and mold in residential environments consistently increased the risk of upper and lower respiratory tract infections, with an exposure-response pattern in which the longer and more frequent the exposure, the higher the risk of infection experienced. Continuously inhaled mold spores can trigger allergic reactions, respiratory tract irritation, and respiratory infections, particularly in vulnerable groups such as children, the elderly, and individuals with low immune systems[8]. Providing and maintaining good air quality can significantly benefit both respiratory and general health by minimizing exposure to airborne contaminants that may impair lung function and increase the risk of disease[16].

From the perspective of waste management, these findings are also relevant to the review by de Titto and Savino (2024), which affirms that inadequate urban solid waste management contributes to air pollution, increased fine particulate matter, and respiratory disorders in communities around waste accumulation areas, through the mechanism of creating habitats for pathogenic microorganisms and disease vectors. High population density, specifically in urban areas, is often associated with poor sanitation, limited access to clean water, and inadequate waste management, creating conditions that facilitate the spread of infectious diseases particularly respiratory infections[15]. In line with this, a study by Eshete, Desalegn, and Tigu (2023) in Ethiopia showed that although community knowledge and attitudes regarding household waste management are generally already fairly good, waste management practices in the field remain poor, affirming that an increase in knowledge alone does not always correlate directly with changes in actual practice, so practical guidance and demonstrations such as those carried out in this activity are necessary so that knowledge can be more easily translated into action. Therefore, education that integrates both aspects, namely humidity/mold control and waste management, accompanied by direct practical demonstrations, is considered more comprehensive than education that focuses solely on the delivery of theoretical information, because both factors are interrelated in the environmental causal chain of ARI[3].

The findings of this activity are also in line with the community service results of Mulyadi, Erlani, Rasman, and Farida (2024), which showed that direct education on ARI prevention measures was able to significantly improve community knowledge, with a pattern of knowledge score improvement that is consistently found in various other community-based health education activities as well. ARI symptoms usually last less than 14 days and include fever, cough, sore throat, nasal congestion, headache, mucus production, and loss of appetite.

Because early symptoms are often mild, many people ignore them, even though the disease can spread quickly through droplets or direct contact. Therefore, health education is essential for ARI prevention[13]. Health education helps increase people's knowledge, which leads to better health practices in their daily lives[14]. The consistency of these findings strengthens the argument that direct interactive education is an effective promotional strategy that can be replicated in other areas with similar environmental problem characteristics, particularly in densely populated areas such as Bubutan District[5].

Although the results of the activity showed a satisfactory improvement in knowledge, several limitations need to be noted. First, this activity used a one-group pretest-posttest design without a control group, so that the score improvement observed cannot be fully separated from the possible influence of factors outside the intervention, such as the effect of repeated questionnaire completion (testing effect). Second, the relatively limited sample size (25 individuals) and purposive nature of the sampling means that the results of this activity cannot yet be generalized broadly to a larger population. Third, the evaluation conducted only measured the knowledge (cognitive) aspect in the short term, while actual changes in PHBS attitudes and practices (behavior) in the field require further monitoring over a longer period of time. Therefore, the results of this activity should be interpreted as preliminary evidence regarding the effectiveness of brief education in improving knowledge, rather than as definitive evidence of long-term behavioral change in the community.

CONCLUSION

The educational activity on ARI risk mitigation due to environmental mold and waste management, conducted at Tembok Dukuh X Balai RT 12 RW 01, Bubutan District, Surabaya, successfully improved community knowledge, as evidenced by an increase in participants' average scores from pretest to posttest. This program is expected to encourage the consistent implementation of clean and healthy living behavior (PHBS) and to create a healthier, cleaner, and more comfortable living environment, thereby reducing the risk of Acute Respiratory Infection (ARI) in the community.

RECOMMENDATIONS

- Environmental health education needs to be conducted on a regular basis so that the knowledge obtained can continue to be remembered and applied.
- Community awareness of household waste management needs to be increased, particularly the sorting of organic and inorganic waste, in order to reduce the risk of damp environments as a medium for mold growth.

- Ongoing monitoring of environmental conditions, including indoor humidity levels and air circulation, is needed by local RT/RW officials and health institutions.
- Further collaboration is needed between educational institutions, local government, and the community to sustain environment-based health promotion programs.

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