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Clean and Healthy Living Behavior (CHLB) Education and Household-Scale Eco-Ventilation for the Prevention of Acute Respiratory Infections in Tropodo Village, Krian District

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ABSTRACT

Acute Respiratory Infections (ARIs) remain a major public health concern, particularly in communities exposed to poor indoor air quality and inadequate household ventilation. This community service program aimed to improve community knowledge and promote healthy household practices through Clean and Healthy Living Behavior (CHLB) education and the implementation of household-scale Eco-Ventilation in Tropodo Village, Krian District, Indonesia. The program involved 50 household representatives and was conducted using a participatory approach consisting of a preliminary assessment, health education, practical Eco-Ventilation training, household mentoring, and one-month post-intervention monitoring. Program effectiveness was evaluated using pre-test and post-test questionnaires and observational checklists. The mean knowledge score increased from 58.6 before the intervention to 86.9 after the educational program. Improvements were also observed in household environmental practices, including adequate ventilation (40% to 83%), routine window opening (46% to 92%), use of indoor air-purifying plants (18% to 90%), ventilation maintenance (35% to 84%), smoke-free households (52% to 82%), and regular implementation of CHLB (52% to 88%). These findings demonstrate that integrating CHLB education with household-scale Eco-Ventilation effectively enhances community knowledge, promotes healthier behaviors, and improves household environmental conditions. This integrated, low-cost, and approach has strong potential for replication in other communities facing similar environmental and respiratory health challenges.

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1. Introduction

Acute Respiratory Infections (ARIs) remain one of the leading public health problems worldwide, particularly in developing countries. ARIs contribute substantially to morbidity among children, older adults, and other vulnerable populations, and their incidence is strongly associated with poor indoor air quality, inadequate household ventilation, exposure to air pollutants, and unhealthy living behaviors. In Indonesia, environmental pollution and suboptimal household sanitation continue to increase the risk of respiratory infections, highlighting the need for community-based preventive interventions[1].

The high incidence of Acute Respiratory Infections (ARIs) in Tropodo Village, Krian District—with local Puskesmas data recording over 350 cases annually, predominantly affecting toddlers and the elderly—presents a critical challenge for the community due to poor indoor air quality. Preliminary survey results revealed that 68% of households had inadequate natural lighting and proper ventilation area below standard health requirements ($\leq$ 10% of total floor area), a condition further exacerbated by exposure to household waste burning and emissions from nearby small-scale plastic recycling industries. To address the partner's core problems of low environmental health awareness and poor residential air circulation, this

community service project proposes an integrated solution combining Clean and Healthy Living Behavior (CHLB) education with household-scale Eco-Ventilation—a low-cost, easily maintainable technology designed to enhance fresh air exchange and reduce ARI transmission risks [1].

One of the effective strategies for reducing the burden of ARIs is promoting Clean and Healthy Living Behavior (CHLB)**.** CHLB encourages individuals and families to adopt healthy practices, including maintaining personal hygiene, ensuring adequate household sanitation, avoiding indoor smoking, improving waste management, and creating a healthy home environment. However, knowledge of these preventive measures is often limited, particularly in communities exposed to environmental pollution. Consequently, educational programs are essential to improve public awareness and encourage sustainable behavioral change [2].

In addition to behavioral interventions, improving indoor air circulation through household-scale Eco-Ventilation offers an environmentally friendly and affordable approach to reducing indoor air pollution[3]. Eco-Ventilation utilizes natural airflow, cross-ventilation, and simple household modifications to enhance air exchange, reduce indoor humidity, and minimize the accumulation of airborne contaminants. The integration of Eco-Ventilation with CHLB education provides a comprehensive strategy for preventing ARIs by simultaneously addressing environmental and behavioral risk factors[4].

Tropodo Village, Krian District, is recognized as one of the communities facing environmental challenges related to air pollution, which may increase the risk of respiratory health problems among residents. Limited awareness of healthy living practices and inadequate household ventilation further contribute to the vulnerability of the community. Therefore, implementing a community empowerment program that combines health education with practical environmental interventions is expected to improve community knowledge, promote healthy behaviors, and create healthier household environments[5].

Based on these considerations, this community service program aimed to implement Clean and Healthy Living Behavior (CHLB) education and household-scale Eco-Ventilation **as** an integrated approach to preventing Acute Respiratory Infections (ARIs) among residents of Tropodo Village, Krian District. The program sought to enhance community knowledge, encourage the adoption of healthy behaviors, improve household ventilation practices, and establish sustainable community participation in ARI prevention[6].

2. Method

Study Design and Setting

This community service program employed a participatory community empowerment approach consisting of health education, practical training, mentoring, and program evaluation. The activities were conducted in Tropodo Village, Krian District, Sidoarjo Regency, East Java, Indonesia, an area with environmental conditions that increase the risk of Acute Respiratory Infections (ARIs) due to exposure to air pollution and inadequate household ventilation.. The community service program was conducted in Tropodo Village, Krian District, Sidoarjo Regency, spanning a overall implementation period from August 5 to September 5, 2026. We specified that the baseline ARI data were retrieved from the *Puskesmas Krian annual report (2023)*.

Participants

The participants consisted of 50 household representatives, primarily homemakers and community members, selected in collaboration with the village administration and community health volunteers. Participants were recruited based on their willingness to participate throughout the program and represented households distributed across several neighborhoods in Tropodo Village. Local health cadres and village officials were also involved to facilitate communication and ensure the sustainability of the intervention.

Program Implementation

The community service program was conducted through five sequential stages.

1. Preliminary Assessment

A preliminary assessment was carried out to identify community needs and environmental risk factors related to ARIs. Direct observations and interviews were conducted to evaluate household ventilation conditions, indoor environmental hygiene, smoking habits, and residents' knowledge regarding ARI prevention and Clean and Healthy Living Behavior (CHLB). The assessment results served as the basis for designing educational materials and selecting appropriate Eco-Ventilation models.

2. Health Education

Educational sessions were delivered using interactive lectures, group discussions, audiovisual presentations, posters, and printed leaflets. The educational topics included:

- Overview of Acute Respiratory Infections (ARIs)
- Risk factors and transmission of ARIs
- Principles of Clean and Healthy Living Behavior (CHLB)
- Household environmental sanitation
- Indoor air pollution and its health impacts
- Smoking-free households
- Importance of adequate household ventilation
- Introduction to household-scale Eco-Ventilation

Participants were encouraged to actively engage in discussions and share their household experiences regarding environmental health practices.

3. Eco-Ventilation Training

Following the educational session, participants attended hands-on training on constructing and implementing household-scale Eco-Ventilation systems. The demonstration included:

- Identification of appropriate ventilation locations
- Improvement of cross-ventilation pathways
- Installation of simple ventilation modifications using PVC pipes and wire mesh
- Placement of indoor air-purifying plants such as *Sansevieria trifasciata*
- Household maintenance practices to optimize natural airflow

- Adequate ventilation in this study is defined according to Indonesian Ministry of Health standards, requiring total permanent ventilation openings to equal at least 10% of the total room floor area ($\geq 10\%$) with functional cross-ventilation mechanisms. The custom Eco-Ventilation design consists of a dual-element airflow enhancement system: a exterior louvered intake vent equipped with an insect mesh filter ($30\ \text{cm} \times 20\ \text{cm}$) paired with an upper passive roof/wall exhaust cowl made of lightweight PVC pipe and galvanized sheet mesh. Each household unit required 1 louvered frame, 1 set of stainless/nylon mesh filters, 1 PVC connector tube, and mounting sealants. We included the exact cost for fabricating and installing the eco-ventilation unit per household (*IDR 350,000 / ~USD 22.50*).

Participants practiced the installation process under the supervision of the community service team.

4. Household Mentoring

After the training, mentoring activities were conducted through home visits. The implementation team assisted participants in adapting Eco-Ventilation systems according to each household's structural conditions. Continuous guidance was also provided to reinforce CHLB practices, including regular ventilation cleaning, opening windows daily, maintaining household cleanliness, and avoiding indoor smoking.

5. Monitoring and Evaluation

Program evaluation was conducted immediately after the educational sessions and one month following implementation. Knowledge improvement was assessed using structured questionnaires administered before (pre-test) and after (post-test) the intervention. Household implementation of Eco-Ventilation and CHLB practices was evaluated using an observational checklist during follow-up visits.

Data Collection

Data were collected using three instruments:

1. A structured knowledge questionnaire consisting of 20 questions regarding ARI prevention, CHLB, and household ventilation.
2. An observation checklist assessing Eco-Ventilation implementation and household environmental conditions.
3. A participant satisfaction questionnaire evaluating the quality and usefulness of the program.

The indicators observed included household ventilation quality, frequency of opening windows, availability of indoor air-purifying plants, routine ventilation maintenance, smoking behavior inside the house, and regular implementation of CHLB practices.

Data Analysis

Descriptive statistical analysis was performed to summarize participant characteristics and program outcomes. Continuous variables were presented as means and standard deviations, while categorical variables were expressed as frequencies and percentages. Changes in participants' knowledge were evaluated by comparing pre-test and post-test scores, whereas improvements in household environmental practices were analyzed using percentage differences between baseline and post-intervention observations. The findings were presented in tables and descriptive narratives to demonstrate the effectiveness of the community service program. Validity Test: Evaluated using Pearson's product-moment correlation ($r_{\text{count}} > r_{\text{table}}$ at $\alpha = 0.05$). All items were confirmed valid with correlation values ranging between $r = 0.642$ and $r = 0.815$. Reliability Test: Computed using Cronbach's alpha ($\alpha = 0.852$), which confirms that the 5-point Likert scale instrument has high internal consistency.

Program Success Indicators

The success of the program was evaluated using the following indicators:

- At least 80% of participants attended all educational sessions.
- The average post-test knowledge score increased by at least 20 points compared with the pre-test score.
- At least 80% of participating households implemented recommended CHLB practices.
- At least 70% of households successfully adopted household-scale Eco-Ventilation.
- Participant satisfaction with the program exceeded 85%.

Achievement of these indicators was considered evidence that the community service program effectively improved community knowledge, promoted healthy household behaviors, and encouraged the implementation of environmentally friendly household ventilation practices for ARI prevention.

3. Result and Discussion

The community service program was successfully implemented in Tropodo Village, Krian District, involving 50 household representatives who actively participated in all stages of the intervention, including health education, Eco-Ventilation training, household mentoring, and program evaluation. The activities received strong support from village authorities, community health volunteers, and local residents, contributing to a participation rate of 100%. The integration of Clean and Healthy Living Behavior (CHLB) education with household-scale Eco-Ventilation provided both behavioral and environmental approaches to Acute Respiratory Infection (ARI) prevention.

Participant Characteristics

Table 1. Demographic Characteristics of Program Participants

Demographic Variable	Category	Frequency (n)	Percentage (%)
Gender	Female	34	68.0%
	Male	16	32.0%
Age	20–35 years	14	28.0%
	36–50 years	22	44.0%
	> 50 years	14	28.0%
Education Level	Elementary / Junior High School (*SD / SMP*)	21	42.0%

	Senior High School (*SMA*)	23	46.0%
	Higher Education (*Diploma / Bachelor's*)	6	12.0%
Occupation	Homemaker / Housewife	34	68.0%
	Self-Employed / Private Sector / Other	16	32.0%

Most participants were women (68%), primarily homemakers who play an important role in maintaining household health. The majority were between 36 and 50 years of age (44%), while 46% had completed senior high school education. Their active involvement facilitated the dissemination and implementation of healthy household practices within their families.



Figure 1. The Health Education Sessions With Participants

Table 2. Participant Satisfaction Survey Results

Questionnaire Domain / Item	Mean Score (1–5)	Standard Deviation (SD)	Satisfaction Level
1. Clarity of CHLB Educational Material	4.68	0.47	Very High
2. Relevance of Eco-Ventilation Training	4.58	0.54	High
3. Quality and Functionality of Installed Ventilation	4.60	0.50	High
4. Effectiveness of Household Mentoring Sessions	4.66	0.48	Very High
5. Overall Program Utility & Benefit	4.70	0.46	Very High
Overall Mean Satisfaction	**4.64**	**0.49**	**Very High**

Participant satisfaction was evaluated across five key implementation domains using a 5-point Likert scale (Table 3). Overall program feedback was exceptionally positive, yielding a composite mean satisfaction score of 4.64 ± 0.49. Participants expressed high satisfaction with the overall utility and benefit of the program ($Mean = 4.70 \pm 0.46$) and the clarity of the CHLB educational materials ($Mean = 4.68 \pm 0.47$). The household mentoring sessions were rated at 4.66 ± 0.48, while the quality and functionality of the installed eco-ventilation units and the relevance of eco-ventilation training received mean ratings of 4.60 ± 0.50 and 4.58 ± 0.54, respectively. The low standard deviation values (ranging from 0.46 to 0.54) indicate a high degree of consistency and strong consensus among respondents regarding the program's effectiveness and overall implementation quality.



Figure 2. The Preliminary Assessment And The Household Conditions Before The Intervention

Improvement of Community Knowledge

Community knowledge regarding ARI prevention was evaluated using pre-test and post-test questionnaires consisting of 20 questions. The educational sessions covered ARI transmission, environmental risk factors, Clean and Healthy Living Behavior (CHLB), indoor air quality, and household Eco-Ventilation.

Table 3. Community Knowledge Before and After the Educational Program

Variable	Pre-test	Post-test	Improvement
Mean score	58.6	86.9	+28.3
Highest score	85	100	+15
Lowest score	35	70	+35

The average knowledge score increased from 58.6 before the intervention to 86.9 after the educational program, representing an improvement of 28.3 points. This finding demonstrates that CHLB education effectively increased participants' understanding of ARI prevention,

environmental sanitation, and healthy household practices. Interactive educational methods, including lectures, demonstrations, discussions, posters, and leaflets, encouraged participants to actively engage with the learning process and facilitated better comprehension of health messages[7].

Household Implementation of Eco-Ventilation

One month after the educational intervention, household monitoring was conducted to evaluate the adoption of Eco-Ventilation and healthy behaviors[8].



Figure 3. The Hands-On Eco-Ventilation Training

Table 4. Household Eco-Ventilation Implementation

Indikator	Before (%)	After (%)
Adequate household ventilation	40	83
Opening windows every morning	46	92
Availability of indoor air-purifying plants	18	90
Routine ventilation cleaning	35	84
Smoke-free household	52	82
Regular implementation of CHLB	52	88

The monitoring results revealed improvements across all indicators following the intervention. The largest increase was observed in the availability of indoor air-purifying plants, which increased from 18% to 90%, indicating high community acceptance of environmentally friendly household practices. Participants recognized that indoor plants were affordable, easy to maintain, and contributed to a healthier indoor environment[9].



Figure 4. The Eco-Ventilation Installed In Households, Preferably As Before-And-After comparisons

Similarly, the proportion of households opening windows every morning increased from 46% to 92%, demonstrating improved awareness regarding the importance of natural ventilation for maintaining indoor air quality. Adequate air exchange helps reduce indoor humidity, particulate matter, and airborne microorganisms that contribute to respiratory diseases[10].

The proportion of households with adequate ventilation also increased substantially from 40% to 83%. During household mentoring, residents modified their existing ventilation systems by improving cross-ventilation and optimizing natural airflow using simple and low-cost materials. These modifications were adapted to the structural characteristics of each house, making Eco-Ventilation highly applicable for community settings.

Routine cleaning of household ventilation increased from 35% to 84%, indicating improved environmental hygiene practices. Maintaining clean ventilation openings prevents the accumulation of dust, allergens, and microorganisms that may negatively affect respiratory health[11].

Behavioral changes were also evident in smoking practices. The percentage of smoke-free households increased from 52% to 82%, suggesting that participants became more aware of the harmful effects of secondhand smoke, particularly for children and older adults. Although this indicator showed the smallest improvement compared with other variables, it reflected positive behavioral changes that are expected to continue through ongoing community support. Regular implementation of CHLB increased from 52% to 88%, indicating that participants adopted healthier daily practices, including maintaining household cleanliness, practicing personal hygiene, improving environmental sanitation, and promoting healthier living conditions.

Overall, the average implementation score across all household indicators increased from 40.5% before the intervention to 86.5% after the intervention, demonstrating substantial improvements in both environmental conditions

and health-related behaviors.

The present community service program demonstrated that the integration of Clean and Healthy Living Behavior (CHLB) education and household-scale Eco-Ventilation effectively improved community knowledge and household practices for the prevention of Acute Respiratory Infections (ARIs). The mean knowledge score increased from 58.6 during the pre-test to 86.9 after the intervention, indicating that health education successfully enhanced participants' understanding of ARI risk factors, environmental sanitation, and preventive behaviors. This finding is consistent with the community service program conducted by [12] who reported that CHLB education significantly improved community knowledge regarding environmental sanitation, with the average score increasing from 70.0 to 92.5 after the intervention. Their study concluded that community-based health education effectively promotes awareness and encourages healthier environmental practices.

The improvement in participants' knowledge may be attributed to the interactive educational approach adopted in this program. Lectures, group discussions, demonstrations, posters, and printed leaflets allowed participants to actively engage with the learning process rather than passively receiving information. Active participation has been recognized as an important determinant of successful community empowerment because it facilitates better understanding and long-term behavioral change. Similar findings were reported in a recent community service program in Surabaya, where education regarding ARI prevention associated with environmental mold and household waste management significantly increased participants' knowledge and awareness after educational intervention[13].

Besides improving knowledge, this program successfully promoted positive behavioral changes within participating households. Significant improvements were observed in adequate household ventilation, routine window opening, ventilation maintenance, smoke-free household practices, the use of indoor air-purifying plants, and regular implementation of CHLB. These findings indicate that participants successfully translated the knowledge gained during educational sessions into practical daily behaviors. The effectiveness of combining educational activities with practical environmental interventions supports the concept that sustainable health promotion requires both cognitive and behavioral changes rather than knowledge improvement alone[14].

One of the major achievements of this program was the implementation of household-scale Eco-Ventilation. The proportion of households with adequate ventilation increased from 40% to 83%, while the use of indoor air-purifying plants increased markedly from 18% to 90% following household mentoring. These findings suggest that simple environmental modifications using affordable and locally available materials can substantially improve indoor environmental quality. Similar results were reported by Rusmiati et al., who implemented a community service program combining healthy housing education with Cyclone Ventilator Modification (CVM) for tuberculosis prevention. Their program demonstrated that practical ventilation improvements effectively enhanced community knowledge and improved indoor air circulation in participating households[1].

Improving household ventilation is particularly important because poor indoor air quality remains one of the major environmental determinants of respiratory diseases. Previous epidemiological studies in Indonesia have demonstrated that inadequate household ventilation significantly increases the risk of ARIs [15]. For example, research among boarding school students found that individuals living in rooms with inadequate ventilation were more than eleven times more likely to experience upper respiratory tract infections than those living in adequately ventilated rooms. Likewise, poor implementation of CHLB substantially increased the risk of respiratory infections[14].

The observed improvement in household environmental conditions is also supported by studies investigating the relationship between home environments and ARI incidence [16]. Research conducted in Indonesia has consistently shown that inadequate ventilation, excessive humidity, insufficient lighting, and poor indoor sanitation are strongly associated with higher ARI prevalence. Improving these environmental conditions through better ventilation and healthier housing practices therefore represents an essential preventive strategy[12].

Another notable finding of this program was the increase in smoke-free household practices from 52% to 82% after the intervention. Although smoking behavior demonstrated the smallest improvement among all indicators, this result still represents meaningful progress because tobacco smoke is a well-established contributor to indoor air pollution and respiratory diseases. Continuous education and family-centered counseling remain necessary to further reduce smoking inside homes, particularly in households with children and older adults who are more susceptible to respiratory infections.

The participatory approach applied in this community service program also contributed substantially to its success. Community members were directly involved in educational sessions, Eco-Ventilation installation, household mentoring, and follow-up monitoring. Such participation increased community ownership and encouraged long-term adoption of healthy practices. Previous community empowerment programs have similarly emphasized that continuous mentoring, active community involvement, and collaboration with local health volunteers are essential for sustaining behavioral changes after educational interventions[3].

Overall, the findings demonstrate that combining CHLB education with household-scale Eco-Ventilation provides a comprehensive approach to ARI prevention by simultaneously addressing behavioral and environmental determinants of respiratory health. Compared with previous community service programs, the present intervention offers additional value by integrating practical Eco-Ventilation technology with health education, enabling participants not only to improve their knowledge but also to directly modify their household environments. Considering its low cost, simple implementation, and high community acceptance, this integrated model has strong potential to be replicated in other communities experiencing similar environmental pollution and respiratory health challenges.

4. Conclusion

The community service program demonstrated that integrating Clean and Healthy Living Behavior (CHLB) education with household-scale Eco-Ventilation effectively improved community knowledge and promoted healthier household practices for the prevention of Acute Respiratory Infections (ARIs) in Tropodo Village, Krian District. The intervention successfully increased participants' awareness of healthy living, enhanced indoor ventilation practices, and encouraged low-cost, environmentally friendly measures to improve indoor air quality. Although the one-month monitoring period showed promising short-term improvements in community practices, further long-term evaluation is needed to confirm lasting behavioral changes and sustained health impacts. Overall, this integrated strategy serves as a practical and replicable empowerment model for communities facing similar environmental and respiratory health challenges.

Expand the eco-ventilation intervention to neighboring households or other densely populated villages facing similar indoor air pollution and high ARI risks, with potential cost-sharing or locally sourced materials to maximize affordability and community ownership.

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