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Multimodal Education and Simulation Training for Emergency Response Knowledge among 'Aisyiyah Cadres

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ABSTRACT

Timely and appropriate community response to medical and environmental emergencies remains a critical public health concern, particularly in settings with limited access to immediate professional care. Gaps in community knowledge of first aid and basic emergency response continue to constrain early action at the grassroots level. As a community-based organization, 'Aisyiyah plays a strategic role in strengthening emergency response capacity through its cadres. This study examined changes in emergency response knowledge following community-based education and simulation training among 'Aisyiyah cadres. A quasi-experimental single-group pre–post design without a control group was conducted among 34 cadres who participated in structured educational sessions, hands-on simulations, and role-play activities focusing on burn management and Basic Life Support (BLS). Knowledge was assessed using a validated true–false questionnaire and analysed using the Wilcoxon Signed-Rank test with effect size estimation. The results showed significant improvements across all domains. The median overall knowledge score increased from 80 (IQR=13) to 90 (IQR=0) ($p<0.001$) with a large effect size ($r=0.56$). Burn management knowledge reached the maximum score for all participants after the intervention (median=50; IQR=0), indicating a strong standardisation effect. BLS knowledge also improved significantly ($p=0.003$) with a moderate effect size ($r=0.36$), although variability in

improvement was observed. These findings highlight the potential of multimodal, community-based training as an entry point for strengthening emergency response knowledge. Achieving optimal and sustained outcomes requires training continuity, periodic reinforcement, and integration with broader community health and disaster management systems through cross-sectoral collaboration.

Keywords
Basic Life Support
Burn Injuries
Disaster Preparedness
Health Cadres
Simulation Training

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Introduction

Indonesia is one of the countries with a high risk of disasters that frequently result in public health emergencies requiring immediate response [1]. Fire-related incidents remain a persistent problem, particularly in residential settings where community members are often the first to encounter victims before professional emergency services arrive [2], [3]. In 2023, fire incidents in Indonesia peaked in June, with 133 reported cases, most of which occurred in residential areas, underscoring the importance of timely and appropriate early response at the community level [2].

Delayed or inappropriate early response can substantially worsen health outcomes during emergencies. Effective community-level emergency response is therefore a critical component of disaster risk reduction and public health preparedness [4]. However, disaster management efforts in Indonesia continue to face challenges related to limited community competence, insufficient emergency response knowledge, and weak integration between community initiatives and formal emergency management systems [5], [6].

Empirical evidence highlights substantial gaps in community knowledge related to first aid and emergency response. An observational study in rural Indonesia reported that 76.2% of respondents lacked adequate knowledge of burn first aid, indicating a significant deficit in basic emergency competencies among community members [7]. Similar patterns of inadequate knowledge and inappropriate first-aid practices have been reported in other populations [8], [9]. In addition to burn injuries, emergencies may involve life-threatening conditions such as cardiac arrest, where timely Basic Life Support (BLS) is essential. Nevertheless, public knowledge and willingness to perform BLS remain limited, particularly outside healthcare facilities [10], [11].

Strengthening community-level emergency response capacity is therefore essential to reducing preventable morbidity and mortality during disasters and acute health events [12],

[13]. Community-based actors play a crucial role in this effort, particularly in contexts where formal health cadres are limited in number or scope. In Indonesia, organizations such as 'Aisyiyah engage community members who are actively involved in social and health-related activities but are not uniformly formalized as official health cadres, such as those in Posyandu. This condition reflects both a capacity gap, due to variations in training and standardization, and a strategic opportunity, given the organization's extensive grassroots reach and substantial social capital.

Various educational and training approaches have been used to improve emergency response knowledge at the community level, emphasizing active learning and contextualized practice. However, evidence on integrated, multimodal training interventions that combine education, simulation, and role play within non-formal community organizations has been less frequently documented, particularly when assessed using structured pre–post study designs in the Indonesian public health context [4], [13]. Therefore, this study aimed to examine changes in emergency response knowledge following community-based education and simulation training among 'Aisyiyah cadres, providing context-specific empirical evidence on the potential contribution of community organizations beyond formal health cadre systems. The novelty of this study lies in integrating these complementary learning approaches within a non-formal community organization and simultaneously addressing two essential components of emergency response: burn management and BLS. By evaluating this integrated approach in a community-based Indonesian setting, this study provides practical evidence for strengthening emergency-response knowledge among community cadres who may serve as first responders during local emergencies.

Material and Methods

A. Study Design

This study employed a quasi-experimental single-group pre–post design without a control group to examine changes in emergency response knowledge following a structured, community-based training intervention.

B. Participants and Sampling Technique

The study involved 34 'Aisyiyah cadres who were actively engaged in community-based activities in Kulon Progo, Indonesia. Participants were selected using purposive sampling based on the following criteria: (1) active involvement in 'Aisyiyah community activities, (2) residence in Kulon Progo, and (3) willingness to participate in the whole training session and evaluation process. These participants represent non-formal community actors who are not uniformly standardized as official health cadres within the formal health system. In addition to demographic characteristics, participants were asked whether they had previously attended

first-aid training related to Basic Life Support (BLS) and burn management. This information was collected to provide context for participants' baseline emergency-response knowledge.

C. Training Intervention

This intervention consists of a structured, multimodal training package focused on emergency response knowledge. The training integrates three sequentially delivered components: (1) didactic instruction introducing key concepts of first aid for fires and burns, as well as Basic Life Support (BLS); (2) hands-on simulations to demonstrate and practice relevant emergency response procedures; and (3) role-playing activities to contextualize emergency response scenarios within community situations. All components are delivered as an integrated learning package within a single training session. The training is conducted by four facilitators with expertise in disaster emergency management and ten assistants with healthcare educational backgrounds. The session lasts approximately seven hours, comprising three hours of didactic instruction, two hours of hands-on simulation, and two hours of role-playing. Simulation activities utilize specific equipment, and participants practice skills using structured scenarios involving fire/burn emergencies and BLS. Participants receive training materials and the opportunity to repeat procedures under instructor supervision. Immediate feedback is provided during the practice sessions, followed by a brief evaluation session after the simulation and role-playing activities conclude.

D. Data Collection and Instrument

Emergency response knowledge was assessed using a researcher-developed 10-item true–false questionnaire based on the American Heart Association (AHA) guidelines for basic life support (BLS) and established principles of burn first aid. The questionnaire comprising 10 true–false items across two knowledge domains: 5 on fire and burn first aid, and 5 on Basic Life Support (BLS). Three outcome measures were derived: (1) overall emergency response knowledge (total score), (2) fire and burn first aid knowledge, and (3) BLS knowledge. Content validity was evaluated using the Content Validity Index (CVI) based on expert review by three subject-matter experts (one public health expert and two emergency medicine experts). Each item was rated for relevance on a four-point scale (1 = not relevant to 4 = highly relevant), with ratings of 3 or 4 indicating content validity. All items met this criterion, yielding an Item-Level CVI (I-CVI) of 1.00 for each item and a Scale-Level CVI (S-CVI/Ave) of 1.00, indicating excellent content validity. No predefined categories of good, moderate, or poor knowledge were applied. An overall internal consistency coefficient was not reported because the questionnaire was designed to assess distinct areas of disaster-related knowledge rather than to function as a unidimensional scale composed of interchangeable indicators of a single underlying construct. The two knowledge domains represented conceptually different content areas; therefore, a single Cronbach's alpha or KR-20 coefficient across all items would not provide a meaningful

estimate of the questionnaire's measurement properties [14],[15]. Representative questionnaire items are provided in the Supplementary Material. Participants completed the questionnaire immediately before (pre-test) and after (post-test) the training intervention.

E. Data Analysis

Descriptive statistics were used to summarize participant characteristics and knowledge scores. Data distribution for overall and domain-specific scores was assessed using the Shapiro–Wilk test. As the data were not normally distributed, pre–post differences in overall emergency response knowledge, fire and burn first aid knowledge, and BLS knowledge were analysed using the Wilcoxon Signed-Rank test. Effect sizes were calculated for each outcome to estimate the magnitude of the intervention's effect. Effect sizes for the Wilcoxon signed-rank tests were calculated using the formula $r = Z/\sqrt{N}$, where Z is the standardized test statistic and N is the number of observations. Effect sizes were interpreted as small (0.10), moderate (0.30), and large (0.50), following Cohen's criteria [16]. Statistical analyses were conducted using SPSS version 25, with a significance level set at $p < 0.05$. Special consideration was given to the burn management post-test results, which showed zero variance because all participants achieved maximum scores, suggesting a potential ceiling effect.

F. Research Ethics

This study received ethical approval from the Health Research Ethics Committee of the Faculty of Medicine and Health Sciences, Universitas Muhammadiyah Yogyakarta (No. 069/EC-KEPK FKIK UMY/II/2025). Written informed consent was obtained from all participants prior to data collection.

Results

A. Participant Characteristics

A total of 34 participants were included in this study, representing a community-based adult population with a mean age of 50.38 years (SD 8.62). As presented in Table 1, the sample was predominantly composed of individuals in the productive age group (41–60 years), suggesting that the intervention reached participants who are likely to play active roles in household and community emergency situations.

The educational profile indicates that most participants had at least secondary education, with a substantial proportion having higher education. This suggests an adequate baseline capacity to understand and apply health-related knowledge. The occupational distribution reflects a heterogeneous community structure, including both formal and informal roles such as teachers, housewives, and other occupations, indicating the potential for broader dissemination of knowledge within the community.

Table 1. Participant characteristics (n=34)

Variable	Category	n	%
Age	<40 year	4	11.8
	41–60 year	25	73.5
	>60 year	5	14.7
Gender	Female	34	100
	Male	0	0
Last education	Paket C (equivalent to senior high school)	1	2.9
	Senior High School / Vocational School	12	35.3
	Diploma/Bachelor's Degree	20	58.8
	Not Available	1	2.9
Occupation	Private Employees	3	8.8
	Teachers	10	29.4
	Housewives	9	26.5
	Retirees	3	8.8
	Others (Village Heads, Civil Servants, Laborers, Traders)	7	20.6
	Not Available	2	5.9
Previous first-aid training (BLS and burn management)	Yes	27	79.4
	No	5	14.7
	Not Available	2	5.9

B. Descriptive Statistics of Pretest and Posttest Scores

As shown in Table 2, scores increased across all domains following the intervention. The overall score demonstrated a notable improvement, accompanied by a reduction in variability, indicating not only higher performance but also greater consistency among participants.

A similar trend was observed in both the BLS and burn management domains. However, burn management posttest scores reached the maximum possible value for all participants, resulting in zero variability. This suggests a strong immediate learning effect and a high level of knowledge standardization in this domain.

Table 2. Descriptive statistics of scores (overall, BLS, and burn management)

Domain	Time	Mean (SD)	Median (IQR)	Min-Max
Overall	Pretest	78.53 (9.26)	80.00 (13)	60–100
	Posttest	91.47 (3.60)	90.00 (0)	90–100
BLS	Pretest	37.65 (6.06)	40.00 (10)	30–50
	Posttest	41.47 (3.60)	40.00 (0)	40–50
Burn Management	Pretest	40.88 (6.68)	40.00 (10)	30–50
	Posttest	50.00 (0.00)	50.00 (0)	50–50

Max: Maximum; Min: Minimum; SD: Standard Deviation

C. Comparison of Pretest and Posttest Scores and Effect Size

Normality testing using the Shapiro–Wilk test indicated that all variables were not normally distributed ($p < 0.05$). In the burn management posttest, normality could not be assessed due to zero variance, as all participants achieved identical scores. Based on these results, non-parametric tests were applied for further analysis.

As presented in Table 3, the Wilcoxon signed-rank test revealed statistically significant improvements across all domains. The overall score showed a significant increase with a large

effect size (r = 0.56), indicating a substantial practical impact of the intervention. This improvement was consistently observed across participants, reflecting a broad effect rather than isolated gains.

In the BLS domain, a statistically significant improvement was observed (p = 0.003) with a moderate effect size (r = 0.36). However, the presence of a considerable number of unchanged scores suggests that the magnitude of improvement varied among participants, indicating a more heterogeneous response compared to the overall score.

In contrast, the burn management domain demonstrated a significant improvement with a large effect size (r = 0.56). Notably, no participants experienced a decline in scores, and posttest results were uniformly at the maximum level. This pattern indicates that the intervention was highly effective in standardizing knowledge in this domain.

Table 3. Wilcoxon signed-rank test and effect size

Domain	Z	p-value	Effect Size (r)
Overall	-4.561	< 0.001	0.56
BLS	-2.982	0.003	0.36
Burn Management	-4.625	< 0.001	0.56

Overall, the findings indicate that the intervention led to meaningful improvements in knowledge across all domains, with the strongest and most consistent effect observed in burn management. The reduction in variability in posttest scores suggests that the intervention not only increased knowledge but also reduced disparities among participants. However, the clustering of scores at the upper limit, particularly in burn management, indicates a potential ceiling effect, which should be considered when interpreting the results.

Discussions

This study demonstrated that community-based education and simulation training significantly improved emergency response knowledge among ‘Aisyiyah cadres across all measured domains. The improvement was reflected in increased median scores and reduced variability, indicating not only enhanced individual knowledge but also greater consistency across participants. These findings suggest that structured, participatory training can effectively strengthen community readiness in emergencies. Community knowledge enhancement in disaster management can be achieved through health education and training using table-top disaster simulations [17]. Furthermore, improving cadres’ knowledge of disaster emergencies is essential for effective risk management, as community skills are necessary to reduce vulnerabilities and enable effective disaster response [18]. A study demonstrated that significant improvements can occur when simulation is integrated into emergency training, thereby enhancing knowledge and preparedness, especially when combined with structured educational components [19]. In addition to knowledge, simulation

training can also significantly improve skills, decision-making speed, and emergency preparedness, thereby reducing errors and increasing participant confidence [20].

The observed improvement in knowledge may also be interpreted through the principles of experiential learning, in which learning is strengthened when participants actively engage with experiences and reflect on their application [21]. In this study, didactic education provided the conceptual foundation, while hands-on simulation and role play created opportunities for participants to actively apply emergency-response knowledge in contextualized scenarios. This combination of conceptual instruction and active experience may help explain the immediate improvement in knowledge observed following the training.

Factors that may influence knowledge include education, experience, age, and access to information [22]. Knowledge level, place of residence, education, and training history are significantly associated with attitudes, although most still possess limited knowledge [23]. In addition, age is also significantly associated with knowledge, with older individuals demonstrating higher levels of knowledge [24]. However, this differs from previous findings reporting no association between education level and respondents' knowledge, indicating the need for educational efforts across all community groups to improve knowledge [9].

A particularly important finding in this study was observed in the burn-management domain, where all participants achieved the maximum post-test score. Although this may indicate strong immediate learning and consistent performance following the training, the result should be interpreted cautiously because the absence of variability may also reflect a ceiling effect. The five-item instrument may have had limited ability to discriminate between participants with higher levels of burn-management knowledge, particularly if the items were relatively simple and protocol-based. Previous research has shown that structured education can improve community knowledge of burn first aid, particularly when the content is practical and easy to understand [25], [26], [27]. However, the uniformly high post-test scores in the present study should not be interpreted as definitive evidence of complete mastery or full standardization of knowledge.

The post-test results for burn-management knowledge should be interpreted cautiously. Although all participants achieved the maximum score of 50, indicating strong immediate performance after the intervention, the absence of score variability also suggests a potential ceiling effect. Thus, the observed result may reflect genuine short-term mastery, but may also partly reflect the limited number and difficulty of the five-item instrument, which may have reduced its ability to discriminate between participants with higher levels of knowledge. Therefore, the finding should not be interpreted as definitive evidence that the intervention fully standardized burn-management knowledge. Future studies should use a

larger pool of items with varying levels of difficulty to improve measurement sensitivity and better distinguish differences in higher levels of knowledge.

This finding highlights the importance of considering ceiling effects when evaluating knowledge interventions. A ceiling effect occurs when scores cluster near the maximum possible value, limiting the ability of an instrument to detect further improvements or differences among participants with higher levels of knowledge [28]. Training evaluations often exhibit ceiling effects due to leniency bias, where participants give uniformly high ratings, obscuring true differences in performance [29]. Therefore, the observed result may reflect both genuine immediate learning and limited measurement sensitivity. Future studies should consider using a larger pool of burn-management items with varying levels of difficulty to better discriminate higher levels of knowledge and provide a more sensitive assessment of intervention effects.

The reduction in post-test score variability indicates that the intervention not only improved knowledge but also reduced gaps among participants. This finding is particularly important in the context of community-based emergency response, where shared understanding is crucial to ensuring coordinated, effective action. Reducing knowledge gaps within community groups can enhance collective efficacy by targeting multiple levels of the social ecology and incorporating skills development and discussion groups [30]. Reducing knowledge gaps within community groups can also improve the responsiveness of the community health system by empowering community members with accurate information [31].

In contrast, although knowledge in the BLS domain also improved significantly, the magnitude of change was more moderate and showed greater variability among participants. This difference may be attributed to the more complex and procedural nature of BLS, which requires sequential decision-making, psychomotor skills, and accurate timing. The intervention in this study involved providing education and training on basic life support (BLS) and burn management. This aligns with research findings indicating that BLS training significantly improves cadres' knowledge in delivering early interventions during emergencies [32]. BLS training has also enhanced practical skills [33].

Furthermore, previous research has reported a significant relationship between BLS knowledge and the ability to perform the recovery position among cadres [34]. Additionally, there is an urgent need for effective first-aid training for burn injuries, where participation in courses, hands-on experience, and media use are important factors in improving knowledge, particularly in remote areas [35]. In contrast, the BLS domain in this study showed a moderate effect size and greater variability in participant improvement. This suggests that BLS

knowledge may be more complex and requires more intensive or repeated training to achieve consistent mastery among participants.

The large effect sizes observed in the overall and burn management domains highlight the substantial practical impact of the intervention, indicating that the training resulted in meaningful improvements beyond statistical significance. Meanwhile, the moderate effect size in the BLS domain suggests that, although the intervention was effective, further reinforcement may be needed to achieve optimal, consistent learning outcomes. The use of effect sizes in this study provides additional insight into the magnitude of change from the training program, which is crucial for evaluating the relevance of community-based training programs [36]. Systematic evaluations have shown that effect sizes can vary across intervention types and should therefore be interpreted with their practical implications in mind [37]. Training interventions with small to moderate effect sizes can yield meaningful improvements in behaviour and practice outcomes, particularly when scalable and sustainable over time [38].

Participant characteristics, including educational background and active involvement in community organizations, may have contributed to the effectiveness of the intervention. Educational attainment can affect cognitive function, particularly by contributing to individual differences in cognitive skills that emerge in early adulthood and persist into later life [39]. Previous research has reported that higher educational attainment is associated with better cognitive performance across various aspects, particularly reasoning [40]. The higher a person's level of education, the better their understanding, which, in turn, affects knowledge acquisition and the overall potential for quality of life [41].

Furthermore, individuals actively involved in community activities may have greater motivation and readiness to learn, thereby enhancing the impact of the training program. Active involvement in learning communities significantly improves motivation, engagement, and learning outcomes due to intensive communication and collaboration among participants [42]. Higher levels of participation in community activities are positively correlated with learning attitudes, self-confidence, and proactive learning behavior, as individuals feel more socially connected and assume greater responsibility for the learning process [43].

These findings have practical implications for community-based disaster preparedness. The multimodal approach combining didactic education, hands-on simulation, and role play could be integrated into routine capacity-building activities for ‘Aisyiyah cadres, supported by periodic refresher training and collaboration with local health and disaster management authorities. Standardized training materials and simple competency monitoring may help maintain consistency across settings. Future research should examine long-term knowledge retention and practical skill performance through longitudinal follow-up and objective skill assessments. Comparative studies with larger and more diverse community populations are

also needed to evaluate effectiveness and implementation sustainability, including the roles of training frequency, facilitator capacity, organizational support, and resource availability.

The intervention was associated with an improvement in emergency-response knowledge immediately following the training, particularly in fire and burn first aid and Basic Life Support (BLS). However, knowledge gain alone does not establish improvement in psychomotor performance, emergency decision-making, behavioral change, or sustained preparedness. These outcomes were not directly assessed in the present study. The observed improvement in knowledge may nevertheless provide an important foundation for preparedness, particularly when reinforced through continued practice, refresher training, and opportunities to apply emergency-response skills in relevant community contexts.

This study has several strengths, including using a contextual, education- and simulation-based training design involving 'Aisyiyah community cadres, which demonstrated significant improvements in participants' knowledge and ensured practical relevance for community-based disaster preparedness. Additionally, integrating quantitative methods, appropriate statistical analyses, and a clear presentation of results further strengthened the study. However, limitations include the quasi-experimental single-group design without a control group, which limits generalizability, and the relatively small, homogeneous sample (female cadres from a single region), which may affect representativeness. Future research with stronger designs and more diverse populations is recommended to reinforce evidence on the intervention's effectiveness.

Conclusion

Education and simulation-based training on burn management and Basic Life Support (BLS) improved the knowledge of 'Aisyiyah cadres in Kulon Progo, with all participants achieving a good knowledge category after the intervention. The multimodal training intervention improved cadres' short-term knowledge of fire and burn first aid and Basic Life Support (BLS). The findings support the potential value of integrating didactic instruction, hands-on simulation, and role play in community-based capacity-building. However, the observed knowledge improvement should not be equated with demonstrated preparedness or emergency-response competence, as psychomotor skills, decision-making, behavioral change, and long-term knowledge retention were not assessed. Further studies are needed to determine whether these immediate knowledge gains translate into sustained knowledge, practical competence, and improved preparedness in community settings.

Limitation and Suggestions

This study has several limitations. First, the single-group pre–post design without a control group limits causal inference; therefore, the observed improvement cannot be

attributed solely to the intervention. Second, the uniform maximum post-test scores in the burn management domain suggest a potential ceiling effect, which may reflect successful immediate learning but may also indicate limited sensitivity of the five-item questionnaire to differentiate higher levels of knowledge. Third, the assessment was conducted immediately after the training; thus, the retention of knowledge and its translation into practical emergency-response skills were not evaluated. In addition, the relatively small and homogeneous sample of female 'Aisyiyah cadres from a single district may limit generalizability. Future studies should employ more rigorous comparative designs, larger and more diverse samples, longer follow-up periods, and assessments of both knowledge and practical skills.

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Conflict of Interest

The authors declare no conflict of interest.

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