

Research Paper

Fire Preparedness and Risk Awareness Among Islamic Boarding School Students in Indonesia: A Quantitative Citywide Survey in Jambi



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ABSTRACT

Background: Fire incidents in Islamic boarding schools (pesantren) in Indonesia continue to occur frequently due to structural vulnerabilities, weak safety protocols, and low student preparedness. However, empirical research specifically addressing fire readiness in pesantren remains limited. This study aimed to examine levels of fire preparedness among pesantren students in Jambi City, Indonesia, by assessing risk awareness, self-efficacy, participation in fire training, and involvement in maintaining safety facilities.

Materials and Methods: A cross-sectional quantitative survey was conducted with 1,857 students from 10 Islamic boarding schools using a 31-item fire preparedness questionnaire developed for the pesantren context. Content validity was established through expert judgment (content validity ratio and content validity index), while construct validity was tested using exploratory factor analysis. Reliability was assessed using Cronbach's α . The data were descriptively analyzed to classify preparedness levels.

Results: Most students were classified as moderately prepared (59.1%), followed by unprepared (36.5%) and highly prepared (4.4%). Although general risk awareness was adequate, students demonstrated low confidence in managing emergencies and limited involvement in fire drills and equipment maintenance.

Conclusion: Fire preparedness in pesantren remains insufficient, particularly regarding practical readiness and self-efficacy. Strengthening simulation-based training, improving inspection routines, and integrating disaster education into the pesantren curriculum are recommended.

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Introduction

Fires in Islamic boarding schools (pesantren) pose a serious and recurring threat across Indonesia, claiming lives and causing substantial material loss each year [1]. National disaster data indicate that only approximately 5% of the nearly 497,576 educational facilities in Indonesia are classified as disaster-resilient, while tens of thousands of pesantren operate without standardized building safety permits, placing students at heightened risk during fire emergencies [2]. Pondok Pesantren Al Mawaddah in Ciganjur, South Jakarta, caused several students to suffer from smoke inhalation and required medical treatment, highlighting the direct health and safety consequences of inadequate fire preparedness [3]. The complexity of pesantren building structures, characterized by dense occupancy, multifunctional rooms, and substandard electrical installations, significantly increases fire hazards [4]. This situation aligns with the all-hazards theory, which emphasizes the importance of comprehensive preparedness for various threats, including fires, floods, and earthquakes [5]. Beyond structural vulnerabilities, pesantren face heightened risks due to limited risk awareness and the absence of a systematic safety management framework [6].

Previous studies have shown that children and adolescents, who make up the majority of pesantren residents, are among the most vulnerable groups during emergencies due to limited danger perception and insufficient response experience [7]. Practical, hands-on safety education programs have proven effective in improving student preparedness [8]. Further studies confirmed that integrating disaster education while involving teachers and firefighters can reduce school fire incidents by up to 25% across Southeast Asia [9, 10]. Nevertheless, most programs primarily target formal schools, leaving pesantren outside the scope of systematic intervention. Furthermore, Subandi et al. demonstrated that a disaster education model based on local wisdom can improve community preparedness by up to 75% [11]. This approach is relevant to pesantren, where strong religious values, communal culture, and Kyai leadership influence collective behavior. However, to date, no comprehensive study has assessed fire preparedness in Indonesian pesantren. This gap indicates the urgent need for research that is not only descriptive but also capable of contributing to the development of a religious, community-based preparedness model [12].

Several field studies have highlighted the weak implementation of safety protocols in educational institutions, including irregular fire extinguisher inspections, infrequent evacuation drills, and the lack of integration between active and passive protection systems [13]. Managerial constraints and limited budgets further exacerbate these issues. Thus, improvements in preparedness must address both technical components (facility improvements, functional equipment) and non-technical aspects (routine training, safety culture development, collaboration with fire departments) [14].

Recent research emphasizes the importance of incorporating Disaster Risk Reduction (DRR) frameworks and the Sendai Framework into pesantren curricula [15]. This approach allows the integration of religious values, local traditions, and modern safety principles. Matharage et al. [16] also argue that empowering communities is essential for sustainable preparedness. Meanwhile, Permana et al. [17] stress that pesantren require empirical, data-driven evaluations to identify systemic weaknesses before designing effective interventions. Given the increasing frequency of fires in Islamic boarding schools and the lack of comprehensive, data-based interventions, this study is relevant and urgent. It aims to fill a critical gap in the literature,

while providing empirical foundations for developing a structured, sustainable fire preparedness model tailored to the socio-religious context of pesantren. By analyzing risk awareness, self-efficacy, and student participation in safety training and facility maintenance [18], this research seeks to make a meaningful contribution to policy development and practical fire risk reduction in pesantren.

Materials and Methods

Research design

This study adopted a quantitative approach using a descriptive cross-sectional design to illustrate the level of fire preparedness among students in Islamic boarding schools (pesantren) in Jambi City, Indonesia. This design was selected to provide a realistic and systematic overview of preparedness conditions without manipulating variables or testing causal relationships. Descriptive quantitative designs are particularly appropriate for disaster preparedness research in educational and dormitory-based settings, where the primary objective is to identify patterns and levels of readiness rather than to infer causality [17].

Population and sample

Based on data from the Ministry of Religious Affairs and supporting local records, the estimated number of Islamic boarding schools operating in Jambi City ranges from 20 to 30. However, discrepancies across data sources indicate that uniform and widely published official figures are unavailable. Therefore, this study defined its population as all actively operating and officially registered Islamic boarding schools within the administrative boundaries of Jambi City during the study period.

Ten Islamic boarding schools agreed to participate and met the inclusion criteria. While these ten institutions do not represent the entire estimated population, they include schools from different sub-districts, educational levels, and management types. As such, they provide substantial coverage of the operational diversity of pesantren in Jambi City, although this limitation is acknowledged and discussed in the limitations section.

In the context of descriptive quantitative research, coverage of approximately one-third to one-half of the total institutional population is considered acceptable for generating a city-wide overview of preparedness conditions.

Therefore, the inclusion of ten Islamic boarding schools, representing approximately 33–50% of the estimated total pesantren in Jambi City, is considered sufficient for descriptive analysis. However, this partial coverage remains a limitation for broader generalization.

Sample and sample selection method

This study used a sample of 1,857 respondents obtained through a stratified random sampling approach to ensure equal representation across education levels. The sample size was determined explicitly using Slovin's formula, not by assumptions or approximations. Using Slovin's formula (Equation 1):

$$1. n = \frac{N}{1 + (e)^2}$$

where n is the sample size, N is the population size, and e is the margin of error. With a margin of error of 5% ($e=0.05$) and an estimated population of approximately 3,500–4,000 students across the ten participating Islamic boarding schools, the calculation yielded a minimum required sample size of approximately 1,750 respondents. The final sample consisted of 1,857 respondents, indicating a high response rate during data collection. Thus, the sample size was calculated using an established formula rather than being derived from subjective estimates. A stratified random sampling technique was employed to ensure proportional representation across educational levels within the pesantren environment. Stratification was based on four educational strata (Table 1).

Student enrollment lists were obtained from each participating pesantren through school administrators. Within each stratum, respondents were selected using simple random sampling. This approach ensured that differences in age, educational background, and boarding experience, which may influence preparedness levels, were adequately represented in the sample [18].

Research instruments and variables

The main instrument is a fire preparedness questionnaire tailored to the context of the pesantren, consisting of 31 statements in five dimensions: Risk awareness, confidence, participation in fire drills, equipment maintenance, and attitude towards prevention. Each item was rated on a Likert scale of 1–5, with preparedness categories: Not ready (31–72), sufficiently prepared (73–113), and very prepared (114–155), following common practices of Likert scale analysis (fire safety awareness scale, 2018; Likert scale examples for surveys, 2021). The questionnaire was tested for validity and reliability (Cronbach's $\alpha > 0.7$) through expert judgment and initial trials, drawing on studies of fire preparedness in schools and educational communities [19].

Table 1. Strata four levels of education

Levels of Education	No.
Islamic primary school	570
Islamic junior high school	698
Islamic senior high school	552
Islamic boarding college student	37

The main instrument used in this study was a newly developed questionnaire specifically designed for the Islamic boarding school context. The development process consisted of six phases:

- a. Identification of indicators from international fire safety education literature and national regulations on school fire safety.
- b. Drafting of 40 initial items, which were refined to 31 items following expert review.
- c. Content validity testing using the content validity ratio and content validity index, involving three DRR experts and two Islamic education experts.
- d. Pilot testing with 120 students from non-sample boarding schools.
- e. Construct validity testing through exploratory factor analysis, which showed adequate factor structure ($KMO > 0.7$).
- f. Reliability testing yielded Cronbach's α values > 0.7 across all subscales.

Data collection procedure

Data collection was carried out using a structured questionnaire distributed through teachers and class coordinators. A total of 1,857 respondents from 10 Islamic boarding schools in Jambi City were analyzed, with the approval of the pesantren manager and parents for respondents under 18 years old. In addition to the structured questionnaire, non-systematic observations of fire safety facilities, such as portable fire extinguishers (APAR), fire alarm systems, and evacuation routes, as well as brief informal interviews with teachers and dormitory administrators, were conducted. These observations and interviews were used solely to provide contextual understanding of the pesantren environment and to support the interpretation of quantitative findings. They were not intended for formal qualitative analysis and, therefore, are not reported as independent qualitative results in this study [20].

Data analysis techniques

Data analysis relies on descriptive statistics with the support of SPSS software, version 25. This process involves calculating frequency and percentages to classify respondents' preparedness levels into three groups: Unprepared, adequately prepared, and highly prepared.

The results of the analysis are presented through a distribution table for each variable. Interpretation was carried out by referring to fire preparedness indicators in educational institutions by comparing them with the results of relevant previous studies [21].

Results

This study involved 1,857 respondents who were students from various levels of education at Islamic boarding schools, including elementary school (30.7%), MTs (37.6%), MA (29.7%), and Mahasantri (2%). Based on gender, respondents consisted of 866 males (46.6%) and 991 females (53.4%). Respondents ranged in age from 6 to 21 years, with the largest distribution in the 13–14 age group (44%). These characteristics show that most of the participants are in adolescence, i.e. a group that has a moderate level of risk understanding but still needs experiential learning to form effective fire response behaviors (Table 2).

As shown in Table 3, the level of fire preparedness varied across educational levels. Students at the Islamic primary school level showed a mean preparedness score of 1.62 ± 0.56 ; 95% confidence interval [CI], 1.57%, 1.66%), indicating that preparedness was generally in the "quite ready" category, although a substantial proportion remained not ready. Similarly, Islamic junior high school students had a mean preparedness score of 1.64 ± 0.55 ; 95% CI, 1.60%, 1.69%), suggesting a comparable preparedness profile with slightly higher consistency. At the Islamic senior high school level, preparedness was relatively higher, with a mean score of 1.76 ± 0.52 ; 95% CI, 1.72%, 1.8%), indicating a descriptive trend of higher preparedness scores at higher educational levels, with a mean score of 2.05 ± 0.78 ; 95% CI, 1.79%, 2.31%). However, the wider confidence interval reflects greater variability within this group, likely due to the smaller sample size.

As shown in Figure 1, the distribution of preparedness across education levels tended to follow a normal distribution, suggesting that most respondents were sufficiently prepared but could still benefit from further training and education programs.

The frequency distribution of the preparedness sub-dimension is demonstrated in Table 4. In terms of fire risk awareness, around 70% of respondents were aware of the potential for fires caused by electricity or human error, although only 20% believed the risk was high, indicating immature perceptions and a lack of preventive urgency [22]. Meanwhile, confidence was low among 56% of respondents in evacuation or the use of fire ex-

Table 2. Distribution of respondent characteristics

Characteristics		No. (%)
Education level	Islamic primary school	570(30.7)
	Islamic junior high school	698(37.6)
	Islamic senior high school	552(29.7)
	Islamic boarding college student	37(2)
Gender	Man	866(46.6)
	Woman	991(53.4)
Age (y)	6	99(5.35)
	7	100(5.4)
	8	77(4.1)
	9	99(5.35)
	10	96(5.2)
	11	99(5.35)
	12	280(15.1)
	13	488(26.3)
	14	328 (17.7)
	15	154(8.3)
	18	8(0.4)
	19	17(0.9)
	20	7(0.4)
	21	5(0.3)
Total		1.857(100)

tinguishers (38% doubted), due to a lack of simulation, which can be improved through training.

Training participation showed that 60% were aware of the importance of training. However, few participated in immediate evacuation due to a lack of regular programs, a common phenomenon in developing countries that requires repetition for retention procedures. Finally, equipment maintenance awareness was weak: 50% reported that inspections were not routine, and only 45% were confident that the equipment was functioning, highlighting structural deficiencies that are crucial for fire control.

These findings are in line with Subandi et al. [11] which described a gap between risk awareness and mitigation practices in boarding educational institutions. This emphasizes the need to strengthen the DRR policy at the pesantren level as stipulated in Jambi Provincial Regulation Number 9 of 2022 on the Facilitation of the Implementation of Islamic Boarding Schools.

Implication

The findings of this study highlight the urgency of implementing a holistic fire risk management strategy in the pesantren environment, where regular fire training through simulations, consistent monitoring and maintenance

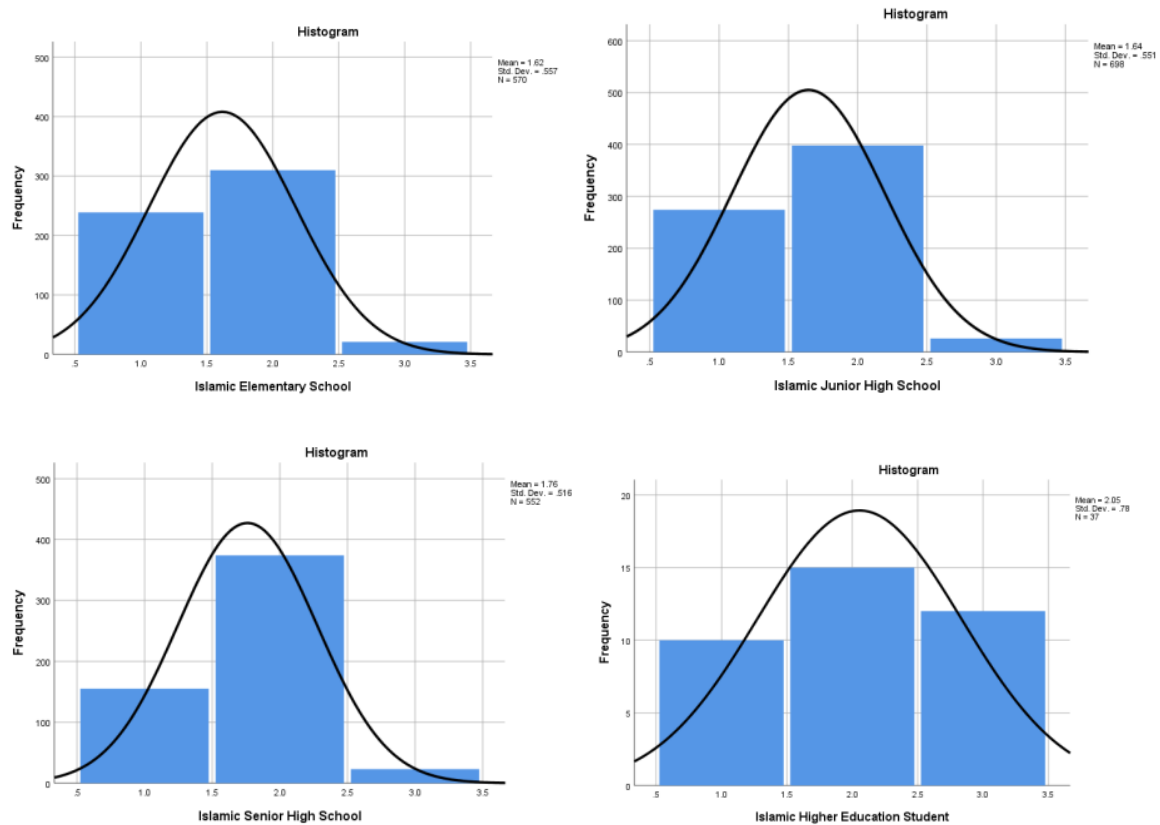


Figure 1. Distribution histogram of preparedness of education

nance of light fire extinguishers (APARs), and the formation of a safety culture through the full involvement of students, teachers, and pesantren managers are crucial elements. These measures will not only strengthen the overall preparedness but also build greater community resilience in the face of fire threats, safeguarding the lives and well-being of all parties involved.

Discussion

The findings of this study indicate that fire preparedness at the Jambi Islamic Boarding School remains adequate, with notable weaknesses in self-efficacy and training participation. This situation is similar to that reported by Widowati et al. [18], where disaster awareness among school students often does not translate into solid preparedness behavior. The lack of direct training makes students less trained to react quickly when an emergency arises. Yao et al. [23] added that understanding theory alone, without repeated simulations, results in superficial readiness. Therefore, building a safety culture in Islamic boarding schools should focus on experiential learning, so that students can become accustomed to facing the risk of fire directly [24].

The self-efficacy factor does play a crucial role in fire preparedness. The low confidence among students in using fire extinguishers or evacuating, as revealed here, is in line with Fazeli et al.'s [2] results which found that simulation exercises can increase participants' confidence by up to 40% compared to ordinary teaching methods. Similarly, Setioputro et al [15] noted that the simulated approach helps form long-lasting practical skills, especially in disaster education in Indonesia. Therefore, fire training in Islamic boarding schools needs to be scheduled regularly, complete with practical assessments, so that progress can be measured clearly [25].

The lack of attention to the maintenance of safety facilities in the pesantren confirms what Barua et al. [26] found, that the success of the safety system is not only about the availability of tools, but also the routine of inspection and maintenance. Many educational institutions have extinguishing equipment, but rarely check them regularly; therefore, the benefits are reduced. To overcome this, the Jambi Islamic Boarding School is advised to develop standard operating procedures (SOPs) regarding inspection schedules, damage reporting, and maintenance responsibilities.

Table 3. Preparedness distribution

Education Level	Category	No. (%)	Mean±SD	95% CI	
				Lower	Upper
Islamic primary school	Not ready	239(41.9)	1.62±0.557	1.57	1.66
	Quite ready	310(54.4)			
	Highly prepared	21(3.7)			
Islamic junior high school	Not ready	274(39.3)	1.64±0.551	1.60	1.69
	Quite ready	398(57)			
	Highly prepared	26(3.7)			
Islamic senior high school	Not ready	155(28.1)	1.76±0.516	1.72	1.80
	Quite ready	374(67.8)			
	Highly prepared	23(4.2)			
Islamic boarding college student	Not ready	10(27)	2.05±0.78	1.79	2.31
	Quite ready	15(40.5)			
	Highly prepared	12(32.4)			
Total		1857(100)			

CI: Confidence interval.

In the pesantren environment, Suyadi et al. [27] highlighted the importance of disaster education tailored to the context and religious values. Instilling Islamic principles, such as trust and social responsibility, can be a moral basis for developing a disaster-response attitude. Meanwhile, Wardhana et al. [28] revealed that involving

religious leaders in training can encourage student participation and strengthen intrinsic motivation to maintain their own safety and that of their surroundings. Thus, the active role of Kyai and Ustadz in the fire program provides stronger legitimacy and encourages students to be fully involved.

Table 4. Frequency distribution of preparedness sub-dimension

No.	Question Items	STS	No. (%)		S	ST
			TS	SRR		
Fire risk awareness						
1	There is a chance that I will have a fire at school.	387(20.8)	711(38.3)	270(14.5)	353(19)	136(7.3)
2	There is a chance that I will face a fire while at school.	462(24.9)	865(46.65)	281(15.1)	140(7.5)	109(5.9)
3	Fires can occur at my school due to machinery or electronic equipment.	386(20.8)	576(31)	356(19.2)	306(16.5)	233(12.5)
4	Fires can occur in my school due to the activities of students/teachers.	392(21.1)	637(34.3)	392(21.1)	216(11.6)	220(11.8)
5	A fire can occur at my school due to the negligence of another party.	321(17.3)	689(37.1)	420(22.6)	246(13.2)	181(9.7)
6	Fires can occur at my school as a result of intentional actions (e.g. vandalism).	748(40.3)	543(29.2)	196(10.6)	154(8.3)	216(11.6)
7	I think my school is at risk in terms of fire.	731(39.4)	673(36.2)	171(9.2)	106(5.7)	176(9.5)

No.	Question Items	STS	No. (%)		S	ST
			TS	SRR		
Confidence						
8	I can stay calm in case of a fire at school.	712(38.3)	700(37.7)	143(7.7)	108(5.8)	194(10.4)
9	In the event of a fire, I can ensure my own safety.	632(34)	686(36.9)	205(11)	100(5.4)	234(12.6)
10	In the event of a fire, I can help my friend with a cool head	534(28.8)	831(44.7)	164(8.8)	131(7.1)	197(10.6)
11	I can get out of the school building safely in the event of a fire.	486(26.2)	781(42.1)	248(13.4)	88(4.7)	254(13.7)
12	I want to play an active role in the school fire emergency response team.	525(28.3)	846(45.6)	135(7.3)	105(5.7)	246(13.2)
Fire training overview						
13	All students and teachers at my school should receive fire training.	375(20.2)	610(32.8)	508(27.4)	99(5.3)	265(14.3)
14	Receiving fire training makes it easier to deal with fires at school.	491(26.4)	726(39.1)	220(11.8)	111(6)	307(16.5)
15	Receiving fire training can prevent fatalities in schools.	497(26.8)	641(34.5)	299(16.1)	98(5.3)	322(17.3)
16	Receiving fire training can reduce material losses due to fires in schools.	576(31)	537(28.9)	292(15.7)	141(7.6)	311(16.75)
Fire prevention awareness						
17	Fires are preventable situations.	516(27.8)	676(36.4)	256(13.8)	126(6.8)	283(15.2)
18	It is easier to prevent a fire than to extinguish it.	447(24.1)	544(29.3)	395(21.3)	135(7.3)	336(18.1)
19	The cost of fire prevention is lower than the loss due to fire	621(33.4)	617(33.2)	142(7.6)	138(7.4)	339(18.3)
Confidence						
20	Fire training in schools should be conducted regularly.	461(24.8)	549(29.6)	407(21.9)	100(5.4)	340(18.3)
Refreshment and mindfulness training						
21	Fire training should be refreshed periodically.	508(27.4)	762(41)	125(6.7)	118(6.4)	344(18.5)
22	Evacuation exercises are essential to deal with fires in schools.	377(20.3)	726(39.1)	200(10.8)	168(9)	386(20.8)
23	All school residents must know the location of the fire alarm.	259(13.9)	710(38.2)	367(19.8)	230(12.4)	291(15.7)
24	All school residents must know the emergency exit at school.	385(20.7)	575(31)	500(26.9)	142(7.6)	255(13.7)
25	Before major activities (e.g. exams or school events), evacuation routes must be ensured to be open.	353(19)	832(44.8)	267(14.4)	130(7)	275(14.8)

Abbreviations: STS: Strongly disagree; TS: Disagree; SRR: Neutral/undecided; S: Agree; ST: Strongly agree.

In essence, this study emphasizes that improving fire preparedness in Islamic boarding schools requires collaboration between education, practical training, and the management of safety facilities. Through these steps, preparedness is no longer just a concept, but an adaptive habit inherent in the routine of students and pesantren administrators [29]. The findings of this study directly address the research objective of identifying the level

of fire preparedness among students in Islamic boarding schools and determining the aspects requiring improvement. The results indicate that preparedness scores tended to be higher among students at higher educational levels, reflecting differences in experience and exposure rather than statistically tested effects, with older students demonstrating better readiness. This aligns with Seddighi et al. [9], who found that preparedness among adoles-

cents increases with cognitive maturity and prior exposure to disaster education. The low level of self-efficacy observed in this study can be explained through several interrelated mechanisms. According to Bandura's theory, self-efficacy is primarily developed through mastery experiences; however, limited exposure to repeated fire simulations in the pesantren context restricts students' opportunities to build confidence in their emergency response abilities. This explanation is supported by Fazeli et al. [2], who reported that school-based fire simulations increased students' self-efficacy by up to 40% compared to conventional classroom instruction. Similarly, Yao et al. [23] emphasized that theoretical knowledge alone, without continuous hands-on practice, results in superficial preparedness that does not translate into confident action during emergencies. Furthermore, the effectiveness of disaster education in pesantren is closely linked to contextual adaptation. Incorporating religious values, local culture, and community leadership provides moral legitimacy and social reinforcement, which are essential for strengthening students' motivation and engagement. This perspective aligns with Suyadi et al. [27] and Wardhana et al. [28], who showed that the involvement of religious leaders, such as Kyai and Ustadz, enhances participation, the internalization of safety norms, and sustained compliance with preparedness programs.

This study concludes that fire preparedness at the Jambi Islamic Boarding School remains adequate, although there are clear weaknesses in self-efficacy and active participation in fire drills. This situation illustrates that fire education programs in Islamic boarding schools tend to emphasize imparting knowledge, rather than the development of real practical skills [30].

The findings are in line with those of Hassanain et al. [31], which demonstrate that school-based preparedness education can significantly improve students' knowledge and response skills for fires. The success of that approach lies in the combination of hands-on simulation and experiential learning.

On the other hand, weaknesses in the maintenance of safety facilities indicate the urgency of a more organized fire management system. Duhung et al. (2022) [32] explained that the effectiveness of the fire safety system in schools does not solely depend on the existence of the equipment, but also on the routine of inspections, audits, and continuous maintenance records [33].

In the social and religious environment of Islamic boarding schools, Fahmi et al. (2024) [34] revealed that including emergency response modules and healthy

behavior into the curriculum based on Islamic values can significantly strengthen students' awareness and safety attitude. This confirms that disaster education in pesantren is more successful if it is adapted to local culture and religious principles [35].

Conclusion

This research strengthens the idea that fire preparedness in pesantren can only be realized through practice-oriented education, sustainable facility management, and instilling Islamic values in disaster learning.

Recommendations

Islamic boarding schools are advised to strengthen fire preparedness through regular simulation training and the implementation of standard operating procedures (SOP) for the maintenance of safety equipment. The integration of disaster education into a curriculum based on Islamic values can effectively increase students' awareness and sense of responsibility for safety. In addition, the use of interactive learning media adapted to the context of the pesantren is also recommended to enrich practical understanding and encourage more active involvement.

Ethical Considerations

Compliance with ethical guidelines

This research received ethical approval from the [University of Jambi](#) (Code: 2147/UN21.8/PT.01.04/2025), and participation was voluntary and based on informed consent. The research was conducted in accordance with ethical principles, including confidentiality, voluntariness, and the protection of respondents' identities. In addition, the research has received official approval from the Jambi Islamic Boarding School and recommendations from local education authorities.

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Authors' contributions

All authors equally contributed to conceptualizing, data collection, analysis, drafting, and revising the article.

Conflict of interest

The authors declared no conflict of interest.

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