Influence of junior high school students' knowledge, attitudes, and practices on earthquake and tsunami preparedness simulations in Padang

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Abstract. Padang, a city highly susceptible to earthquakes and tsunamis, requires students to possess adequate knowledge and develop cautious behaviors when confronted with such calamities. This study seeks to evaluate the influence of earthquake and tsunami simulations on junior high school students' learning, perspectives, and practices. A pretest-posttest experimental design was used, involving eighth and ninth-grade students from SMP Negeri 4 Padang. The simulation exercises included earthquake and tsunami disaster drills. Data was collected through observation, focusing on the learning process and the school's preparedness, including evacuation route planning. Of 87 respondents, 42 (48.3%) were male, and 45 (51.7%) were female. The age distribution was as follows: 2 students (2.3%) were 12 years old, 33 (31%) were 13, 48 (50.6%) were 14, and 15 (16.1%) were 15 years old. The simulations substantially improved students' understanding, attitudes, and behaviors in dealing with earthquakes and tsunamis ($p < 0.05$). The earthquake and tsunami simulations at SMP Negeri 4 Padang effectively enhanced students' knowledge, attitudes, and disaster preparedness. The drills improved their awareness and response to emergencies, particularly in following evacuation procedures. This hands-on approach solidified their theoretical understanding and fostered a proactive mindset towards disaster management.

1 Introduction

Indonesia is ranked 36th with a ratio index of 10.36 out of 172 most disaster-prone countries in the world based on the 2018 World Risk Report data, making Indonesia prone to natural disasters such as earthquakes, tsunamis, and volcanic eruptions [1]. Padang City consists of small islands and coastal areas, and it consists of small islands, coastal areas, and hills with an altitude between 0-1,853 meters above sea level. It is directly adjacent to the Indian Ocean, which has quite large sea waves, and there are active tectonic plates that are vulnerable to natural disasters [2].

One of the efforts of disaster preparedness is earthquake and tsunami disaster simulations given to students so as to increase insight and knowledge of disasters that will be faced and be able to behave if a disaster is in sight. Proactive preparedness is disaster management carried out through preparedness in the social recovery stage. This action can be carried out by various parties, including health workers [2]. Pediatricians have an important role in disaster management for children. As outlined in Law of the Republic of Indonesia Number 35 of 2014 concerning child protection, every child has the right to special protection in certain situations and conditions to obtain a guarantee of security against threats that endanger themselves and their lives in their growth and development [3].

This study discusses the knowledge and attitudes of Junior High School students toward earthquake and tsunami disasters and the role of simulation in improving students' knowledge. This study aims to determine whether earthquake and tsunami simulations impact the knowledge and attitudes of junior high school students toward earthquakes and tsunamis.

1.1 Geographical and demographic situation of West Sumatra

According to Regional Regulation Number 10 of 2005, Padang City has an area of 1,414.96 km2, between 00 44 00'-1 08 35' South latitude and 100 05 05'-100 34 09' East longitude. Padang City has a coastal region of 68.126 km2 and a row of Bukit Barisan covering an area of 486.209 km2. The Padang City area has varying land elevations between 0-1,853 meters above sea level. The city's boundaries are Padang Pariaman Regency to the north, Pesisir Selatan Regency to the south, Solok Regency to the east, and the Indian Ocean to the west [4].

1.2 Definition and classification of disasters

A disaster is an event or series of events that threaten and disrupt people's lives and livelihoods influenced by

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natural, non-natural, or human factors and result in casualties, environmental damage, property losses, and even impact human psychology. In the Law of the Republic of Indonesia Number 24 of 2007 concerning Disaster Management, based on the cause, disasters are grouped into three types:[5]

a. Natural disasters are natural disasters caused by natural events, such as earthquakes, tsunamis, volcanic eruptions, floods, droughts, hurricanes, and landslides.
b. Non-natural disasters are caused by non-natural events or a series of events, including technological or construction failure, modernization failure, epidemics, and disease outbreaks.
c. Social disasters, caused by events or a series of events caused by humans, include social conflicts between groups or communities and terror.

1.3 Mentawai megathrust

The Mentawai megathrust area is part of the Sumatra subduction zone with a very high level of seismicity and a risk of earthquakes with magnitudes of more than 8 SR to 9.3 SR and a return period of hundreds of years. In the last two centuries, four earthquakes have been recorded in the Sumatra subduction zone, namely in 1833 with a magnitude of 8.8–9.2; in 1861 with a magnitude of 8.3–8.5; in 2004 with a magnitude 9.0-9.3; and in 2005 with a magnitude 8.7. The segmentation of the Mentawai megathrust may collapse in the next few decades, triggering large earthquakes and tsunamis and potentially causing severe damage in most parts of Sumatra. This disaster threat will mainly affect several cities and regions on the West Coast, such as Sibolga City, Padang City, Pariaman City, Agam Regency, South Coast Regency, and Bengkulu City [6].

1.4 Management of disaster management implementation

Disaster management is a series of efforts that include establishing development policies at risk of disasters, disaster prevention activities, emergency response, rehabilitation, and reconstruction. The implementation of disaster management is divided into three stages according to the disaster management cycle:[7]

a. Pre-disaster, including situations with no disaster and situations with potential disaster.
b. Emergency response, covering the situation when a disaster occurs.
c. Post-disaster, covering the situation after a disaster.

1.5 Pre disaster

Pre-disaster disaster management is carried out in non-disaster situations and potential disaster situations. In non-disaster situations, a disaster management plan covers all stages of disaster work. Meanwhile, in a potential disaster situation, a preparedness plan is prepared to deal with emergencies, namely contingency plans. Activities carried out when a problem does not occur:[5]

1. Disaster management planning.
2. Mitigation (disaster risk reduction).
3. Prevention activities
4. Guidance in development planning
5. Disaster risk analysis
6. Education, training, and standardized requirements according to technical
7. Implementation and enforcement of spatial plans.

1.6 Disaster emergency response

The Activities that are carried out when there is a potential disaster situation:

1. Preparedness is a series of activities to anticipate disasters through organization and appropriate and effective steps.
2. Early warning is an effort to take quick and appropriate action and prepare emergency response actions carried out through observation of disaster symptoms, analysis of the results of observations of disaster symptoms, decision-making by the authorities, dissemination of information about disaster warnings, and action by the community.

1.7 Management of children's disaster management

Based on Law Number 35 of 2014 concerning child protection, a child is someone who is still in the womb until 18 years old. Every child has the right to survival, growth, and development, as well as protection from violence, discrimination, and protection in certain situations and conditions to guarantee security against threats that endanger themselves and their lives in their growth and development. Children have vulnerabilities related to anatomical, physiological, developmental, and behavioral characteristics that increase their risk of disaster. Child protection is all activity to ensure and protect children and their rights to live, grow, develop, and participate optimally according to human dignity. The threat of the Mentawai megathrust requires helping infants and children in the Mentawai megathrust segmentation area, such as Padang City, as a form of child protection efforts in disaster management [7, 8].

The pre-disaster management program includes disaster mitigation education, strengthening school buildings such as earthquake-resistant school buildings, facilities for disaster anticipation such as shelters or tsunami anticipation, emergency stairs, and evacuation route signs. The Disaster Safe Education Unit (PSAB) program was designed by a team of experts in collaboration with the Tsunami Alert Community (KOGAMI) and is targeted for implementation by elementary school students in grades I–V, junior high schools in grades VII and VIII, and senior high and vocational schools in grades X and XI. Earthquake and tsunami disaster simulation is a small part of preparedness [9].

Actions that can be taught during and after an earthquake are:

a. If you are inside the house when you feel earthquake tremors, it is recommended to get under a table to protect yourself from objects that may fall. If there is no table, a pillow can protect the head. If you have a stove on, turn it off immediately to prevent a fire. If it feels safe, immediately leave the house and stand in a safe place.
b. If you are at school, children can take shelter under a desk, and if the earthquake has subsided, it is advisable to exit to find an open space. Children are warned not to stand near buildings, poles, and trees.
c. Teach children to remain calm, not panic when an earthquake occurs, and follow all earthquake-related instructions.
d. If the earthquake has stopped, give knowledge to children, such as checking your condition, your family, and your surroundings; stay away from cracked and unsafe buildings; always be vigilant about aftershocks; and do not panic.

In disaster management efforts, pediatricians have a role that is realized starting with disaster mitigation efforts, continuing to the emergency response stage, and during rehabilitation by the organization's capabilities. As the front guard in disaster situations, pediatricians must have competencies related to disasters and emergencies for children affected by disasters. This is intended so that, in an emergency, pediatricians can work as expected.7 Therefore, there is a need for routine training on disasters and emergencies and their mitigation, especially for children [10, 11]. In addition, pediatricians should support collaboration with other disciplines, such as social services, education, and pharmacy, to advocate for the needs of children in disasters.

In line with the West Sumatra government's contingency plan, Law No. 35/2014 on Child Protection states that special protection for children in emergencies can be carried out through rapid treatment efforts, including physical, psychological, and social treatment and rehabilitation, as well as prevention of disease and other health problems. Another protection effort is to provide psychosocial assistance during treatment and recovery [3]. Some of these efforts can be carried out, especially by pediatricians, in a disaster. The role of pediatricians can be divided into roles before a disaster, during a disaster, and after a disaster.

1.8 The role of pediatricians before disasters

Pediatricians, individually or collectively, as part of the pediatric community (e.g., the American Academy of Pediatrics, the local pediatrician community, and hospital staff) should participate in the development of disaster plans. Pediatricians should provide input to the government and regional offices of Emergency Medical Services (EMS) to ensure that the needs of children are incorporated into any disaster, including emergency plans to meet the needs of critically ill and injured children. Pediatricians can assist schools and childcare centers in developing disaster plans. In addition, they can prepare, update, and practice office disaster plans regularly. Pediatricians are also encouraged to provide anticipatory guidance on disaster preparedness at home.

1.9 Earthquake and tsunami disaster preparedness simulation

Preparedness simulation is an activity conducted to test tsunami-fixed procedures and improve the effectiveness of early warning systems using disaster scenarios that are close to or by the natural conditions when a tsunami occurs (Fig. 1). The implementation of simulation can be done partially or only partially, or the implementation is limited to certain areas that constitute part of the total area of the disaster-prone regions. However, simulations should be conducted routinely on a large scale to produce better overall disaster resilience. The higher the risk of a city or region to tsunamis, the more complete the tsunami simulation should be and involve all stakeholders related to tsunami disasters. The 2014 BNPB guidelines on earthquake and tsunami disaster preparedness simulations explain the types of simulations:

1. Socialization (Orientation Exercise),
2. Evacuation Drill Exercise,
3. Table Top Exercise,
4. Functional Exercise and
5. Integrated Simulation (Full Scale Exercise/End-to-End Simulation/FTX).

These simulations can be carried out at the national, provincial, city, district, or local level. However, each region can choose the type of simulation to be implemented according to its needs and capabilities. The simulation implementation can also combine several types of simulations to get better and more comprehensive results.

Earthquake and Tsunami Disaster Preparedness Simulation:

1. Preparation
2. D-day implementation of the simulation
   a. Opening
   b. Mechanisms during the simulation (spontaneity and dynamics and simulation time flow)
3. Closure
4. Monitoring, Evaluation, Documentation

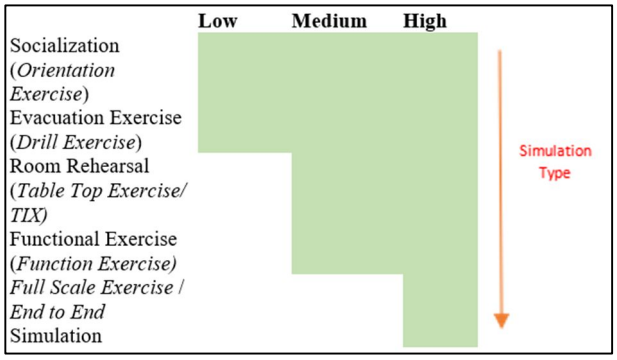

Fig. 1. Consideration matrix for simulation type selection based on risk level

2 Methods

The type of research used is quantitative research with a pre-experimental design and one group pretest-posttest to examine the knowledge and attitudes of SMPN 4 Padang students about earthquake and tsunami disaster preparedness after an earthquake and tsunami disaster simulation in 2023.

In this study, the intervention was provided in the form of simulated evacuation exercises (drill exercises) to SMPN 4 Padang, with the following information:

1. Activity form: evacuation drills at community level, such as schools
2. Actors: school community, especially students
3. Organizers: PPDS Pediatrics, BPBD Padang City, KOGAMI, KSB
4. Location: SMPN 4 Padang School involves Temporary Evacuation Site (TES) Youth Center Building
5. Preparation: Coordinated with the village, school, and security for about 1-2 weeks to prepare pre-simulation material on Tuesday, July 11–12, 2023, for the school.
6. Simulation time: Thursday, July 13, 2023, about 1-4 hours

Some activities to prepare for evacuation drill simulation activities are:

1. An earthquake and tsunami disaster risk assessment are provided to school parties, namely teachers and students.
2. Earthquake and tsunami contingency plan
3. Earthquake and tsunami disaster scenarios
4. Bordering and stabilization from BPBD Padang City and KOGAMI
5. HR as simulation actors and simulation committee
6. Simulation facilities and infrastructure related to the tsunami early warning system's tsunami evacuation plan (signs, evacuation routes, evacuation maps, evacuation sites, tsunami TES, etc.)
7. Funds for simulation activities
8. Mass mobilization.

The research was conducted at SMPN 4 Padang, West Sumatra, July 12–17, 2023. This research was conducted using primary data, which was obtained directly from junior high school students using a questionnaire. The population of this study were all students of SMPN 4 Padang, West Sumatra. The sample in this study is part of the population of SMPN 4 Padang students obtained from proportionate stratified random sampling. Based on the Slovis formula, the sample size required from a population of 650 people with the necessary calculation in this study was 87 respondents, and we obtained 43 students for class VIII and 44 students for class IX.

Data was collected by distributing questionnaires to respondents. The points of this research questionnaire were adopted from the LIPI preparedness questionnaire, which the researcher modified after discussing it with several experts in the field of disaster. The questionnaire Data was collected by distributing questionnaires to respondents. The points of this research questionnaire were adopted from the LIPI preparedness questionnaire, which the researcher modified after discussing it with several experts in the field of disaster. The questionnaire consisted of 35 questions answered in about 15–20 minutes, with 25 yes-or-no questions and 10 true-or-false questions. Part of the questionnaire consists of:

a. Respondent characteristics include name, gender, date of birth, class, and residence address.
b. Yes or No option questions: 25 questions
c. There were ten questions with true or false answers.

In evaluating the knowledge and attitudes of SMPN 4 Padang students, an assessment was made of the material presented in the earthquake and tsunami disaster simulation. The measuring instrument used consists of 35 items with two forms of answers, namely "yes" or "no" answers on items 1–25 and "true" or false" answers on items 26–35. The answer "yes" is worth 1, and the answer "no" is worth 0. The answer to the question "True" or "False" is given a score of 1 if the answer matches the answer key and 0 if the answer does not match the answer key.

2.1 Validity and reliability test

The Sampling for the questionnaire trial was carried out on 30 students of SMPN 13 Padang whose characteristics are almost the same as those of SMPN 4 Padang students, with a filling time of about 15 to 20 minutes. This trial activity is to determine the validity and reliability of the questionnaire. Based on the validity test, 17 valid questions were obtained from 35 questions, with valid validity values ranging from 0.362 to 0.679 ($r > 0.361$). To determine reliability, the Crombach Alpha test was carried out and resulted in an alpha value of 0.768 (≥ 0.6, meaning the question is reliable).

The data collected is primary data. Data was obtained from respondents among SMPN 4 West Sumatra students by distributing questionnaires. After the data was collected completely, processing was carried out using SPSS 24. Univariate and bivariate analyses were carried out on the variables used in this study.

3 Results and discussion

The general description of the research subjects will be described in detail below, namely in the form of subject distribution based on gender, age, and class. The description was obtained from 87 students at SMPN 4 Padang who became the research sample. Then, the frequency and percentage of each distribution were calculated using descriptive statistics.

Table 1. Number of respondents based on gender

Gender	Total	Percentage	Mean	
			Pretest	Post-test
Male	42	48.3%	6.67	11.45
Female	45	51.7%	7.36	11.64
Total	87	100%		

Based on the Table 1, it can be seen that there are 42 people (48.3%) of research subjects who are male and 45 people (51.7%) of research subjects who are female.

Table 2. Number of respondents based on age

Age	Total	Percentage	Mean	
			Pretest	Post-test
12 Years	2	2.3%	6	11
13 Years	27	31%	6.30	10.96
14 Years	44	50.6%	7.32	11.93
15 Years	14	16.1%	7.64	11.57
Total	**87**	**100%**		

Based on the Table 2, it can be seen that there were 2 people (2.3%) research subjects aged 12 years, 33 people (31%) aged 13 years, 48 people (50.6%) aged 14 years and 15 people (16.1%) aged 15 years.

Table 3. Number of class-based respondents

Class	Total	Percentage	Mean	
			Pretest	Post-test
Grade 8	39	44.8%	7.08	11.69
Grade 9	48	55.2%	6.98	11.44
Total	87	100%		

The Table 3 shows that 39 (44.8%) students were in Grade 8 and 48 (55.2%) students were in Grade 9. This normality test was carried out using the Kolmogorof Smirnov test with a p value> 0.05.

Table 4. Normality test

	Kolmogorov-Smirnov[a]		
	Statistic	Df	Sig.
Pre_test	0.157	87	0.000
Post_test	0.154	87	0.000

Based on the data in the Table 4, it can be seen that the pret-test and post-test significance values are normally distributed, because the significance value is <0.05.

3.1 The impact of junior high school students' knowledge, attitudes, and practices on earthquake and tsunami disaster simulation in Padang

Based on the paired sample test conducted, the following results were obtained:

Table 5. The impact of junior high school students' knowledge, attitudes, and behavior on earthquake and tsunami disaster simulation in Padang

Paired Samples Correlations		**N**	**Correlation**	**Sig.**
Pair 1	Pre_test and Post_test	87	0.646	0.000

Based on the Table 5, it can be seen that, the significant result obtained is 0.00 which means the sig. value <0.05 so that there is a relationship between the pre-test and post-test in SMPN 4 Padang students. Judging from the correlation value of 0.646, this relationship is categorized as a moderate relationship.

4 Conclusion

The earthquake and tsunami simulation conducted at SMP Negeri 4 Padang significantly improved the knowledge, attitudes, and practices of junior high school students. The simulation played a crucial role in enhancing students' understanding of disaster preparedness and their ability to respond effectively to potential disasters. Prior to the simulation, many students had limited knowledge of the appropriate actions during such emergencies. However, after participating in the drills, they demonstrated greater awareness and readiness, especially regarding evacuation procedures and safety measures. This hands-on experience helped solidify theoretical knowledge and fostered a more proactive and cautious approach to disaster management among students' general description of the research subjects will be described in detail below.

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