



Disaster Preparedness of High School Students in Red Zone and Green Zone

Emil Huriani^{a*}, Adliah Wulan Sari^b, Tiurmaida Simandalahi^c

^{a,b,c} Faculty of Nursing, Universitas Andalas, Limau Manis, Padang, Indonesia

*e-mail correspondence: emilhuriani@nrs.unand.ac.id

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Abstract

Background: Disaster mitigation was focused on the red zone that making kind of differences in students' preparedness levels between the red zone and green zone. Meanwhile, Padang City has the potential for a Megathrust earthquake of 8.9 SR. This research aimed to determine the comparison in earthquake and tsunami disaster preparedness levels of high school students in the red and green zones.

Methods: This research was a descriptive comparative study. The sampling technique used the cluster random sampling method as many as 139 high school students from the red zone and 136 high school students from the green zone. The research instrument used preparedness questionnaire from LIPI/UNESCO/ISDR.

Results: The results of this study showed that there were significant differences in preparedness ($p < 0,001$) as well as another parameter namely knowledge ($p = 0.030$), emergency planning ($p < 0,001$), early warning systems ($p < 0,001$), and resource mobilization capacity ($p = 0.015$) between high school students in the red zone and the green zone. High school students in the red zone had higher preparedness, knowledge, emergency response plans, early warning systems and resource mobilization compared to students in the green zone.

Conclusion: The preparedness of high school students in the red zone needs to be continuously improved. It is hoped that schools can complete risk maps, evacuation routes, gathering points, create preparedness guidelines and hold disaster management simulation activities for students. The nursing profession can participate in disaster risk education and campaign for disaster preparedness bags in an effort to increase student preparedness in all vulnerability zones.

Keywords: Earthquake, Preparedness, Students, Tsunami, Zone.

INTRODUCTION

United State Geological Survey (USGS) has been named Indonesia as the country that most often experiences earthquakes after Japan. This is because Indonesia is in a seismic zone and has a large area. During the period from January 1 to December 29, 2022, earthquakes with a magnitude above 5 occurred as many as 205 events and 22 of them were destructive.

West Sumatra based on its geographical location is on the coastline of the island of West Sumatra which is located at the meeting of the Eurasian plate and the Indo-Australian plate accompanied by the Semangko fault and close to the Mentawai fault, which forms active segments and makes the West Sumatra region a high

potential for earthquakes (Fitria et al., 2021). The Mentawai fault on the western outer part of Siberut island has the potential for earthquakes with a magnitude of up to 8.9 SR (Fidia et al., 2018). Based on data from BMKG in 2022, 9 damaging earthquakes with a magnitude above 5 SR were recorded during learning activities at school.

Earthquakes that occurred in West Sumatra in 2007 and 2009 destroyed 2,800 school buildings and the Mentawai earthquake in 2010 destroyed 7 school buildings (Mutiawati et al., 2023). The Padang earthquake in 2009 left 60 students dead (Syarif & Mastura, 2015). Public High Schools in Padang City encountered moderate to severe damage due to the 2009 Padang earthquake were SMAN 12, SMAN 1, SMAN 2, and SMAN 10 (Fadhilah & Prabowo, 2010). SMAN 2 is a school that is closest to the beach compared to other high schools.

From the data on the number of victims available, it appears that the community does not fully have preparedness for earthquakes and tsunamis. This is important to note because students in schools are adolescent age communities who are classified as one of the vulnerable groups that need to be considered in terms of reducing the impact of disaster risk (Marlyono & Triyanto, 2023). The vulnerability of adolescents to disasters is driven by limited knowledge about the risks around them, resulting in a lack of preparedness in facing disasters (Devica Pearl et al., 2020).

According to the Indonesian Institute of Sciences (LIPI) and United Nations/Internasional Strategy for Disaster Reduction (UNISDR), preparedness is one of the important elements in the pre-disaster stage in the disaster management process as a pro-active disaster risk reduction measure (Koswara & Triyono, 2011). Parameters to take into account the level of preparedness in responding to disasters issued by LIPI and UNISDR are knowledge of disasters; emergency response plan; early warning system; and resource mobilization (Koswara & Triyono, 2011).

To knowing the preparedness for earthquake and tsunami disasters, the Padang City government has described the location of the danger zone in the government's evacuation location mapping management by dividing three tsunami-prone zones. High Risk Zone (red zone), Medium Risk Zone (yellow zone), and Low Risk Zone (green zone) (Oktiari & Manurung, 2010). In his research mentioned high preparedness is important for every population, so that according to common logic, if an area is prepared and has high preparedness for disasters, then there should be no significant difference in terms of preparedness between its populations (Yong et al., 2020). SMAN 14 is the school that is furthest from the beach compared to other high schools. Yet, education programs on disaster preparedness were more intens in the red zone compared to green zone, resulted in discrepancy on disaster preparedness among students.

High preparedness is important for every population, so according to common logic, if an area is prepared and has high preparedness for disasters, then there should be no significant difference in terms of preparedness between its populations (Yong et al., 2020). Based on the results of research from Huriani et al. (2021), less than half of students at SMAN 2 Padang, located in the red zone, had high preparedness in facing the risk of earthquakes and tsunamis. Another phenomenon found that high school students in Tasikmalaya and Garut had low preparedness and had incomplete facilities and infrastructure owned by schools (Marlyono & Triyanto, 2023).

Knowing the difference between red and green zone disaster preparedness has two advantages: it helps identify the shortcomings of green zone preparedness to improve disaster prevention and impact reduction capacity and reformulate appropriate disaster education programs to improve preparedness (Yong et al., 2020). This study aims to find out the difference in earthquake and tsunami disaster preparedness for public high schools in the red zone and in the green zone.

METHODS

This quantitative study used a descriptive comparative design to identify the difference in earthquake and tsunami preparedness in public high schools in the red zone with the green of Padang City in 2024. The research was conducted at SMAN 2 Padang in West Padang District as a representative of schools located in the red zone and SMAN 14 Padang in Lubuk Kilangan District as a representative of schools located in the green zone. The

sampling technique was cluster random sampling method, there were 139 students from the red zone and 136 students from the green zone.

The parameters used are LIPI/UNISDR standardized preparedness in (Koswara & Triyono, 2011). The parameters used include knowledge, early warning systems, emergency response plans, and resource mobilization. Instruments were used demographic characteristics questionnaires and preparedness questionnaires from LIPI/UNESCO/ISDR with parameters used including knowledge, early warning systems, emergency response plans, and resource mobilization. This questionnaire contains 31 questions and includes several sub-questions in each item and consists of 4 preparedness parameters as follows (Koswara & Triyono, 2011). The total score is calculated using the Guttman scale. Positive questions on the choice of "Yes" are given a value (1) and "No" are given a value (0), while negative questions on the choice of "Yes" are given a value (0) and "No" are given a value (1) (Sugiyono, 2019). The total score is in the range of 0 to 95, the maximum score per parameter is: 1) Knowledge (61), 2) Emergency Response Plan (19), 3) Early Warning Systems (10), 4) Resource Mobilization (5). The score is then calculated and categorized based on the value index, namely the value of 79.50-100 in the high preparedness category, 55.00-79.40 in the medium preparedness category, and the value of <55.00 in the low preparedness category (Koswara & Triyono, 2011). The value of instrument validity is calculated by correlation product moment with values ranging from -0.243 to 0.644. While the reliability results obtained from calculations Chrobach's Alpha is 0.722 (Natalia, 2017).

This research has been approved by the Health Research Ethics Committee of the Faculty of Nursing, Andalas University No.200.layaketik/KEPKFKEPUNAND. Univariate data analysis using frequency distribution tables and bivariate analysis using the Mann Whitney U Test.

RESULTS

Based on Table 1, it is known that most of the respondents were female in the red zone and green zone. The largest distribution of respondent classes was from level X in the red zone and in the green zone.

Table 1. Characteristics of respondents (n=275)

Characteristics	Red Zone (n=139)		Green Zone (n=136)		Total (n=275)	
	f	%	f	%	f	%
Gender						
Male	58	41,7	51	37,5	109	39,6
Female	81	58,3	85	62,5	166	60,4
Class						
X	51	36,7	49	36,0	100	36,4
XI	45	32,4	46	33,8	91	33,1
XII	43	30,9	41	30,1	84	30,5
Total	139	100	136	100		

Table 2. Preparedness and its parameters among high school students in red zone and in green zone (n=275)

Variable and parameters	Red Zone (n=139)		Green Zone (n=136)	
	f	%	f	%
Preparedness				
High	76	54,7	35	25,7
Moderate	59	42,9	88	64,7
Low	4	2,9	13	9,6
Knowledge				
High	89	64,0	71	52,2
Moderate	49	35,3	59	43,4
Low	1	0,7	6	4,4
Variable and parameters	Red Zone (n=139)		Green Zone (n=136)	
	f	%	f	%

Emergency response plan				
High	35	25,7	41	30,1
Moderate	88	64,7	69	50,7
Low	13	9,6	26	19,1
Early Warning Systems				
High	104	74,8	63	46,3
Moderate	20	14,4	43	31,6
Low	15	10,8	30	22,1
Resource mobilization				
High	94	67,6	74	54,4
Moderate	24	17,3	26	19,1
Low	20	14,4	36	26,5

Table 3. Differences on earthquake and tsunami disaster preparedness and its parameters among high school students in red and green zones

Variable and parameters	Red Zone (n=139)		Green Zone (n=136)		p-value
	f	%	f	%	
Preparedness					
High	76	54,7	35	25,7	<0,001
Moderate	59	42,4	88	64,7	
Low	4	2,9	13	9,6	
Knowledge					
High	89	64,0	71	52,2	0,030
Moderate	49	35,3	59	43,4	
Low	1	0,7	6	4,4	
Emergency response plan					
High	76	54,7	41	30,1	<0,001
Moderate	59	42,4	69	50,7	
Low	4	2,9	26	19,1	
Early Warning Systems					
High	104	74,8	63	46,3	<0,001
Moderate	20	14,4	43	31,6	
Low	15	10,8	30	22,1	
Resource mobilization					
High	95	68,3	74	54,4	0,015
Moderate	24	17,3	26	19,1	
Low	20	14,4	36	26,5	

Based on Table 2, it was found that the preparedness of public high school students in the red zone was most in the high category. Furthermore, in the most knowledge parameter was in the high category, in the emergency response plan parameter was the most in the medium category, in the early warning system parameter was the most in the high category, and in the resource mobilization parameter was the most in the high category.

Moreover, it was found that the preparedness of public high school students in the green zone was most in the medium category. Furthermore, in knowledge parameter was in the high category, in the emergency response plan parameter was the most in the medium category, in the early warning system parameter was the most in the high category, and in the resource mobilization parameter was the most in the high category.

Based on Table 3, of the total 139 respondents in the red zone, most students had high preparedness. But there were still students with low levels of preparedness. Meanwhile, of the total 136 students in the green zone, the most students were at moderate preparedness. But there were also students with a high level of preparedness. From the results of statistical tests, a value of $p < 0.05$ ($p < 0.001$) was obtained, so there was a significant difference in the preparedness of public high school students in the red zone with the green zone against the earthquake and tsunami disaster in Padang City in 2024.

In the knowledge parameter ($p = 0.030$), emergency response plan ($p < 0.001$), early warning system ($p < 0.001$), and resource mobilization ($p = 0.015$) in public high schools in the red zone with the green zone of Padang City in 2024, so that there were significant differences in the parameter of knowledge, emergency response plans, early warning systems, and resource mobilization in Public High School students in the red zone with the green zone against the earthquake and tsunami disaster in Padang City in 2024.

DISCUSSION

Preparedness and its parameters for Public High School Students in the Red Zone.

The preparedness of public high school students in the red zone is most in the high category. Furthermore, in the knowledge parameter, early warning systems and resource mobilization were most in the high category, while in the emergency response plan parameter the most in the medium category. The results of this study are in line with previous research on preparedness (Jufrizal et al., 2023), knowledge (Herawati et al., 2023; Mutia et al., 2023); Emergency Response Plan (Nurvianti et al., 2021), early warning system (Muzani et al., 2020) and resource mobilization (Mutiawati et al., 2023).

Most respondents had knowledge of high disaster preparedness. This can be done well if in the pre-disaster stage students make careful preparations (Theophilus et al., 2019). Students learn information about disasters from TV or radio. Akbar (2021) said that geography learning has contributed to improving student preparedness in schools. There are other media such as TV programs and information disseminated through social media to a wide population to help increase students' knowledge about the characteristics, signs, and self-protection from disasters (Akbar et al., 2021).

Knowledge of earthquakes and tsunamis helps in fostering motivation and eliminating reluctance so that a sense of preparedness arises to deal with earthquakes and tsunamis (Zainatunnisa & Satria, 2018). Attending self-rescue training will have an impact on high preparedness and preparation of plans prepared if a disaster occurs. Students are expected not only to know but to reach the level of evaluation or assessment of the ability to face the threat of earthquakes and tsunamis according to the concept of knowledge according to Notoatmodjo (2018), as a consideration that 60 victims of the earthquake disaster in Padang in 2009 are students (Fidia et al., 2018).

In the parameter of emergency response plans, most respondents have a high percentage of emergency response plans. This shows that most students understand the preparation before a disaster occurs. Widodo (2021) mentioned that the use of disaster simulation methods has an effect in improving student preparedness in dealing with earthquakes and tsunamis. This disaster simulation includes training and self-rescue activities as well as safe evacuation places during disasters.

On this parameter, students have not realized the need to save school needs (in bags/bags/plastic). School supplies are important equipment to prepare in terms of emergency response plans because students will be needed when displaced in the process of organizing emergency schools (Ministry of Education and Culture, 2018). This is useful to anticipate the delay in aid coming due to other impacts arising from disasters such as cutting off road access.

On early warning system parameter, most respondents have a high percentage of early warning systems. Socialization and determination of sound agreements need to be carried out throughout the school community as a sign of disaster hazard warning as well as to inform the school community that the situation is safe and the cancellation or tsunami alert appeal has ended from the authorities (Rahayu, 2020). It is beneficial that students can know when the memorial ends and a safe return time so that fatalities can be minimized. In addition, socialization by providing knowledge can reduce students' anxiety levels about safe situations and prevent prolonged panic (Rahmawati et al., 2022).

On resource mobilization parameter, most respondents have a high percentage of resource mobilization. However, there is a question that is least true, namely that the item has participated in PMR activities. PMR activities are beneficial for students and the surrounding community if a disaster occurs in their environment,

students can play an active role in becoming disaster volunteers with knowledge supplies obtained from PMI (PMR Wira, 2020).

Preparedness and its parameters for Public High School Students in Green Zones

The preparedness of public high school students in the green zone is most in the medium to high category. Previous research on the preparedness of junior high school students in green zones showed moderate category preparedness (Devica et al., 2020). On the knowledge parameter most respondents have a high percentage of knowledge. Akbar (2021) said that geography learning in schools has contributed to improving student preparedness. The internet is one of the media that students can easily use in accessing information about disasters to increase students' knowledge about the characteristics, signs, and self-protection from disasters.

Perception influences behavior as awareness in analyzing and responding to disasters (Naseri & Kang, 2017). However, some students often underestimate disaster risk and are very rarely involved in disaster preparedness activities, leaving them unprepared for disasters. Risk perception and a sense of security play a big role in motivating someone to take action when a disaster occurs such as avoiding a disaster (Aksa et al., 2020). It is important to correct students' perceptions in the green zone that even if they are in the safe zone, earthquake tremors can be felt strongly up to the green zone and there will be a possibility that they will go to the red zone.

In the emergency response plan parameter, most respondents have a moderate percentage of the emergency response plan. This shows that students do not fully have planning in dealing with disasters. BNPB (2019) explained that one of the pre-disaster activities that must be carried out to improve preparedness is to prepare a self-rescue plan and conduct useful exercises in dealing with earthquakes (Theophilus et al., 2019).

In the emergency response plans parameter, respondents reported low availability of maps and evacuation/rescue routes in schools. The evacuation location map shows which locations in the school are safe and can be used as gathering points in the event of a disaster. Discussions and meetings regarding evacuation routes are important so that students understand the safe location of disasters in schools. Schools in the green zone do not have evacuation route directions or maps of evacuation locations scattered in schools. This can hinder students in the evacuation process which can lead to the risk of casualties in the event of an earthquake with a large strength.

On early warning system parameter, most respondents have a high percentage of early warning systems. The green zone is a low vulnerability zone and is included in the category of safe from tsunami disasters. So if students in the green zone are in the green zone when the early warning siren sounds, then students do not need to evacuate to other places because they are already in the tsunami safe zone, to avoid congestion (Tim Kaji Cepat Bersama, 2012). But students in green zones still need to take shelter from aftershocks or landslides due to being in hilly areas (Wahyuni, 2011).

In this parameter, respondents reported low frequency of participating in disaster warning exercises/simulations. The early warning system is an effort to distribute disaster warning information to students. Exercises and simulations when hearing early warnings need to be carried out so that if they hear a disaster warning, the school community can immediately respond and evacuate to a safe zone in a short time according to the location (Muis & Anwar, 2018).

On resource mobilization parameter, most respondents have a high percentage of resource mobilization. To reduce disaster risk, BNPB in 2006 established a Disaster Preparedness School (SSB) to increase the sense of security for the school community, especially the students and transfer it to the wider community, such as the community and their respective families (Muis & Anwar, 2018). By Hyogo Framework for Action (HFA) that disaster impact reduction priorities need to be made in the education sector, thus school-age children and adolescents as one of the vulnerable groups during disasters are important to pay attention to and protect their rights (BNPB, 2012).

Differences in Preparedness of Public High School Students in the Red Zone with the Green Zone

There is a significant difference in preparedness for public high school students in the red zone with the green zone against earthquakes and tsunamis. Based on Koswara & Triyono (2011), areas that have high risk potential for earthquakes are expected to have high preparedness for disasters to reduce the risk of these disasters. Although it is a low tsunami vulnerability zone, earthquake tremors can have an impact on the green zone, so students in the green zone also need to require high preparedness for earthquakes. The same high preparedness must be possessed by students in the red zone and green zone to avoid the impact of disasters (Devica et al., 2020).

High school students in Pangandaran red zone also were better prepared than high school students in Tasikmalaya green zone (Marlyono & Triyanto, 2023). There were differences in knowledge of public junior high school students in the red zone and green zone towards the earthquake and tsunami disaster in 2020 (Mutiarra et al., 2020).

One effective method in disaster preparedness improvement activities is the disaster simulation method as Japan does for students in its schools, carried out at the beginning of each semester and must be followed by school residents (Budianto, 2017). Disaster training and simulation as well as disaster lecture activities are more often carried out in the red zone than the green zone considering that the red zone has a higher vulnerability so that activities are focused on schools on the beach (BNPB, 2023). Government conducted disaster education and simulation in a routine basis -yearly or twice a year- in the red zone, however, the green zone did not receive it routinely.

There was a significant difference in emergency response plans for public high school students in the red zone with the green zone to earthquakes and tsunamis. A study that is in line is research from Devica et al., (2020) which states that there are differences in emergency response plans for public junior high school students in the red zone and green zone to the earthquake and tsunami disaster in Padang City in 2020. Schools with good emergency response plans will form a school preparedness section where preparedness planning will be regulated by the agency and not impose responsibility only on teachers (Mutiarra et al., 2020). The hope is that schools can complete evacuation route instructions and gathering points so that students can prepare emergency response plans before disasters occur. In addition, schools are also expected to be able to adopt Japanese preparedness measures in preparing go-bags in each class to anticipate if disasters occur during school class hours (Budianto, 2017).

There are significant differences in the parameter of the early warning system for public high school students in the red zone with the green zone against earthquakes and tsunamis. Research that is in line is research from Devica et al., (2020) which states that there are differences in the early warning system of public junior high school students in the red zone and green zone against the 2020 Padang City earthquake and tsunami disaster. The difference in the percentage of high early warning systems in the green zone is almost double that of the red zone.

Most areas in the red zone were equipped with tsunami early warning sirens (Tim Kaji Cepat Bersama, 2012). If there is an earthquake that poses a tsunami risk, sirens will be activated to notify students and the public to evacuate immediately to a safe place and stay away from the red zone (BMKG, 2013). Conversely, the green zone is generally used as a tsunami disaster evacuation site because of its high area (BMKG, 2013). However, the introduction of a tsunami early warning system needs to be carried out on students in green zones. Because it does not rule out the possibility that students from the green zone will be in the red zone.

There was a significant difference in resource mobilization among public high school students in the red zone with the green zone against earthquakes and tsunamis even though students in both zones had high category resource mobilization. A study that is in line is research from Devica et al., (2020) which states that there are differences in the mobilization of public junior high school students in the red zone and green zone against the earthquake and tsunami disaster in Padang City in 2020.

PMR extracurricular activities discuss evacuation routes, safe places, first aid, and evacuation drills. PMR activities discuss stretcher making and first aid. There has never been a disaster evacuation simulation activity for students in the green zone against the background of the green zone location that is safe against tsunamis.

Exercises and simulations appear to be more centered in red vulnerability zone schools (BPBD, 2023). This is allegedly behind the difference in preparedness in the parameter of student resource mobilization.

CONCLUSION

There were differences between preparedness, knowledge, emergency response plans, early warning systems, and resource mobilization in higher public high school students in the red zone than public high school students in the green zone. High school students in the red zone had higher preparedness, knowledge, emergency response plans, early warning systems and resource mobilization compared to students in the green zone.

The preparedness of high school students in the red zone needs to be continuously improved. It is expected for the nursing profession or those serving in nursing services to be the frontline who play an active role in procuring scientific contributions to improve disaster preparedness among students, in particular. This effort can be done by organizing disaster risk prevention seminars and campaigning for disaster preparedness bags. Furthermore, to be able to hold independent training and from school representatives in the form of disaster simulation activities as an effort to support student preparedness to anticipate earthquakes and tsunamis both in the red zone and green zone.

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