

Journal of Turkish Science Education

<http://www.tused.org>

© ISSN: 1304-6020

Reading the 'Litc-Tsu' wave: a comprehensive analysis of socio-demographic determinants of tsunami literacy

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ABSTRACT

Tsunamis are destructive disasters that threaten those living in vulnerable areas, such as Indonesia's coastal regions. Tsunami literacy (Litc-Tsu) plays an important role in reducing risk and increasing preparedness. This study attempts to explore in depth the factors behind the level of Litc-Tsu. Socio-demographic characteristics such as gender, age, and proximity to the coast are of interest for in-depth investigation to determine whether they are related to the level of Litc-Tsu, especially among teenagers, who are the target of this study. In conducting our research, we used a quantitative study through an exploratory survey design conducted on 260 students in Lampung Province, Indonesia, due to its geological vulnerability to tsunamis, namely, the presence of Mt. Anak Krakatau and the subduction zone on the southern coast of Lampung, which has the potential for megathrust earthquakes. The results we obtained will be analyzed using descriptive and inferential statistics, including structural equation modeling (SEM), independent t-tests, and ANOVA. The findings we processed concluded that (1) the gender factor, where the Litc-Tsu level of women is higher than that of men, significantly affects Litc-Tsu; (2) the age factor does not significantly affect or correlate with Litc-Tsu, with our findings limited to only one age group (adolescents); and (3) the geographical proximity factor does not significantly affect or correlate with Litc-Tsu; our findings indicate that there needs to be an in-depth investigation within the scope of the coastal corridor (+/- 1 km) rather than across the entire regency area. Nevertheless, these findings enrich the scientific knowledge base for constructing evidence-based tsunami mitigation strategies for adolescents that account for socio-demographic factors.

RESEARCH ARTICLE

ARTICLE INFORMATION

Received:

02.09.2025

Accepted:

16.02.2026

Available Online:

21.09.2026

KEYWORDS:

Age, coastal proximity, disaster preparedness, gender, socio-demographic factor, tsunami literacy.

To cite this article: Widodo, S., Abdurrahman., Utami, R. K. S., & Suhendro. (2026). Reading the 'Litc-Tsu' wave: a comprehensive analysis of socio-demographic determinants of tsunami literacy. *Journal of Turkish Science Education*, 23(3), 534-553. <http://doi.org/10.36681/tused.2026.026>

Introduction

Tsunamis are destructive natural disasters, so it is very important to understand the potential risks in vulnerable areas and formulate appropriate strategies to reduce the impact of tsunamis (Srinivasa Kumar & Manneela, 2021; Tufekci-Enginar et al., 2021; Yulianto et al., 2023; Widodo et al. 2025). The end of 2004 became an unforgettable moment in history for communities living along the

Indian Ocean coastline, as a massive earthquake triggered high waves that claimed tens of thousands of lives, destroyed buildings, and caused psychological trauma to those affected (Benazir & Oktari, 2024). Furthermore, in 2018, similar events occurred on the Palu-Donggala coast and the Lampung-Banten coast. These tsunami events emphasize the necessity of awareness and preparedness for future tsunami disasters. In this context, tsunami literacy serves as a crucial foundation in developing future disaster mitigation strategies, including understanding the potential, mechanisms, and decision-making processes involved in protecting oneself before and after a tsunami (Khairunnisa et al., 2021; Nagata et al., 2022; Putri et al., 2025; Takahashi et al., 2025). Through tsunami literacy, they can also improve disaster resilience and quality of life in the future (Çalışkan et al., 2021). In essence, Litc-Tsu is closely related to their ability to implement effective and efficient measures when a disaster occurs (Aksa et al., 2024; Cabello, 2022; Ebina & Sugawara, 2024; Nagata et al., 2022; Takahashi et al., 2025), while their proactive behavior determines the success of disaster risk management (Kesumaningtyas et al., 2022).

In fact, Litc-Tsu levels are uneven across different social groups due to socio-demographic factors such as age, gender, education level, and geographical proximity of residence to disaster-prone areas. These factors are considered important determinants of Litc-Tsu levels (Cugliari et al., 2022; Moreschini et al., 2025). The results of the study by Cerase and Cugliari (2023) indicate that these elements are important in shaping their views on how to behave to be resilient to disasters. Several studies also agree that these elements need to be identified to help develop effective risk communication strategies to support disaster mitigation policies (Armaş, 2006; Doyle et al., 2014; McIvor et al., 2009; Parsons & Lykins, 2023). However, we highlight that several studies remain limited to specific contexts and are fragmented, so the results are not generalizable to factors such as age, gender, and proximity to the coast. This study offers an in-depth analysis by examining the influence and correlation of several socio-demographic factors with Litc-Tsu levels and understanding the strength of these three factors interacting with each other in structural equation modeling.

Several gaps we found involve three elements that we observed. First, surveys on tsunami awareness are still limited to what has been discussed in previous studies. In Indonesia, studies on disaster awareness tend to focus on specific disasters such as tsunamis (Deta et al. 2025; Handoyo et al., 2024;), floods (Fatmah et al., 2022; Sultan et al., 2024), and landslides (MacAfee et al., 2024; Suharini et al., 2024). Second, limited attention has been given to individuals at the college or university level. We found that previous research often focused on communities living in coastal areas, elementary and middle school students in places such as Pangandaran, Indonesia (Nuraziz et al., 2023), and the general public in Nias, Indonesia (Aksa et al., 2024). However, it is important to emphasize that the entire community has an important role to play, not just those living in coastal areas, because these research areas are prone to disasters, and understanding tsunami disaster literacy requires a comprehensive approach. Third, socio-demographic variables such as age, gender, and physical distance were studied separately rather than collaboratively, including, for example, the relationship between age and disaster understanding (Dewi et al., 2025; Genc et al., 2022), gender and disaster understanding (Sari et al., 2022), and location and disaster understanding (Senkbeil et al., 2025).

Therefore, this study explores the extent to which socio-demographic characteristics influence understanding of tsunamis. Empirically derived findings can inform the formulation of strategic disaster mitigation measures that account for socio-demographic factors in the delivery of risk information, preparedness, and decision-making simulations to address disasters effectively.

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Literature Review

Gender and Litc-Tsu

The studies we highlighted earlier mention that gender is recognized as a factor that can influence a person's ability to cope with disasters (Go, 2024; Hall et al., 2022; Mardialina et al., 2024;

Seddighi et al., 2022; Vu et al., 2023). However, we explored further whether there were differences in findings regarding who was more dominant between men and women. Tropus et al. (2024) stated in their study that men had higher preparedness than women, but this result contrasts with findings from other studies, such as Kesumaningtyas et al. (2022), which found that women were more dominant disaster preparedness. Several other studies have revealed that women have a higher perception of risk and a greater sense of responsibility towards their families, which affects their level of preparedness (Najafi et al., 2015; Tohan et al., 2024).

In fact, data show that women are more likely to die in tsunamis (Raheem et al., 2025; Zarook, 2022), due to gender inequality during early warning and field evacuation (Jayasekara et al., 2023). Nevertheless, women demonstrate more dominant caring and preparedness behaviors than men, making them more vulnerable before, during, and after disasters (Fatouros & Capetola, 2021; Sedghi et al., 2025). Through the contradictory consensus of this study's findings, we synthesize that gender is an important factor in influencing their capacity to cope with disasters.

In the context of this study, we want to conduct a specific investigation into the understanding of the tsunami disaster among teenagers and want to reinforce and refute the results of previous studies on whether males or females have Litc-Tsu skills among teenagers (Generation Z), in addition to analyze whether gender factors have a significant effect on Litc-Tsu. The research goal for the substance of this section is as follows:

Hypothesis 1: Gender is influential and correlated with Litc-Tsu levels, and female groups are more dominant in Litc-Tsu skills than male groups?

Age and Litc-Tsu

Age is an important factor in influencing a person's Litc-Tsu ability. Several studies that we tracked found and agreed that there is a positive and significant relationship between the two variables (Genc et al., 2022; Hall et al., 2022; Khairunnisa et al., 2021; Seddighi et al., 2022; Vu et al., 2023). Sun and Sun (2019) in their study mentioned that age can have a positive impact on individuals' readiness in decision making. Furthermore, a study conducted on the coast of Sri Lanka mentioned that age differences influence individuals' ability to respond to early warning systems and evacuations during disasters (Jayasekara et al., 2023).

However, the results of these studies are still contradictory. One such study, as Gülsoy et al. (2025), concludes that as a person's age increases, their level of disaster preparedness literacy decreases. Furthermore, Tohan et al. (2024) support this through their study findings that there is no significant correlation between age and disaster preparedness. The diversity of these findings strengthens our decision to follow up with our study, which focuses on the Gen Z group aged 17-21 years, allowing us to explore the differences based on one-year intervals. The hypothesis we propose in this section is as follows:

Hypothesis 2: Does age affect and correlate with Litc-Tsu levels, and does age group interval affect their Litc-Tsu proficiency?

Geographical Proximity and Litc-Tsu

The geographical proximity of their place of residence is an important factor influencing differences in their understanding of disaster literacy. Several studies highlight that the closer they live to the sea, the higher their awareness of the dangers of tsunamis (Khairunnisa et al., 2021; Vu et al., 2023). This is supported by a study by Sherman-Morris et al. (2025), which found that those who live close to the coast were more capable of making decisions during emergencies. This means that this factor plays an important role in their awareness, understanding, and preparedness for disasters.

The deeper we delve into the literature review, the more we find studies that contradict previous findings or remain inconsistent with one another, such as O'Neill et al. (2015), who found no correlation between the two variables (the distance between disaster-prone areas and their anxiety

about disasters). This was followed by Senkbeil et al. (2025), who found that their understanding of their place of residence (geographical proximity) correlated with their perception of risk, although it was not as consistent as other factors (age, experience, or level of education). These contradictory findings sparked our interest in conducting further investigations on Generation Z. The hypothesis we propose in this section is as follows:

Hypothesis 3: Does the factor of geographical proximity of residence influence and correlate with the level of Litc-Tsu, and do regional differences in city levels affect Litc-Tsu patterns?

Methods

Research Design

This study used an exploratory quantitative cross-sectional survey design to examine the impact, differences, and relationships between determining factors and the school community's level of understanding of tsunamis. This design was chosen to systematically measure the level of understanding and investigate how social background characteristics, such as gender, age, and proximity of residence, contribute to knowledge about tsunamis. It is reasonable to expect that gender differences affect understanding of tsunamis due to differences in social roles and perspectives on danger; that age affects understanding due to its connection with decision-making experience; and that geographical position generally shapes daily perceptions of tsunami-prone areas. A total of 260 individuals participated in this study, which was conducted at the University of Lampung campus in Lampung Province. Details regarding the characteristics of the respondents are presented in Table 1.

Table 1

Participant characteristics

Aspect	Options	Frequency	Percentage (%)
Gender	Male	217	83.14
	Female	43	16.48
Age	16 year	1	0.38
	17 year	28	10.73
	18 year	59	22.61
	19 year	98	37.55
	20 year	67	25.67
	21 year	7	2.68
	2023	86	32.95
Level	2024	94	36.02
	2025	80	30.65

Research Site

The investigation in this study was conducted at a university in Lampung Province. This choice was based on the university's location and the looming threats such as megathrust earthquakes and eruptions of the Anak Krakatau volcano in the Sunda Strait. Participants were selected from students in Lampung Province.

Data Collection

Data were collected using tests that had been validated for construct and content validity by several experts. We developed these test instruments based on indicators that we had previously compiled from a review of relevant literature. The details of the test instrument development are shown in Table 2.

Hypothesis 3: Does the factor of geographical proximity of residence influence and correlate with the level of Litc-Tsu, and do regional differences in city levels affect Litc-Tsu patterns?

Table 2

Development of the Tsunami literacy (Litic-Tsu) instrument

Assessment Aspect	Indicators	Items	References
Critical Understanding	Understanding the causes and natural processes of tsunamis Distinguishing between factual and false (hoax) information in disaster contexts Evaluating the social and environmental impacts of tsunamis	10	The Sendai Framework for Disaster Risk Reduction 2015-2030 (United Nations, 2015); Nagata et al (2022);
Situational Analysis	Identifying early warning signs of tsunamis Analyzing high-risk geographical features Evaluating safe evacuation routes and essential needs during evacuation Analyzing physical, social, and psychological barriers in evacuation processes	10	The Sendai Framework for Disaster Risk Reduction 2015-2030 (United Nations, 2015); Nagata et al (2022);
Systematic Action	Preparing an emergency “go-bag” prior to a tsunami Evacuating according to designated routes and procedures Evacuating calmly and in an orderly manner Informing authorities or evacuation groups of one’s condition	10	León et al (2021); Nagata et al (2022);
Decision-Making	Making rapid decisions when impacted by tsunami waves and selecting the best evacuation option Choosing the fastest and safest evacuation route while weighing consequences Making independent decisions without waiting for instructions during emergencies Adjusting plans in response to obstacles without panic	10	Nagata et al (2022);
Adaptation	Pre-disaster adaptation Adaptation during a tsunami Post-disaster adaptation	10	Plümper, et al (2017); Nagata et al (2022);
Responsive, Solution-Oriented, and Collaborative Actions	Assisting children or the elderly during simulations Creating solutions when facing technical constraints during evacuation Collaborating with peers during evacuation	10	The Sendai Framework for Disaster Risk Reduction 2015-2030 (United Nations, 2015)

This measurement tool has undergone validation to ensure its reliability and suitability for use in this study. Initially, there were 60 items, but only 55 passed validation. The validation process was carried out by distributing the measuring instrument to students who were not part of the main research sample, in order to ensure that the instrument met the psychometric requirements of the research. Scale assessments were given if participants answered correctly (score of 1) or incorrectly (score of 0). We compiled each indicator to create a new measurement tool that focuses on measuring how well someone understands tsunamis, because understanding of tsunami literacy is still lacking when measured on its own; most measurements assess disaster literacy in general. We carried out the validation through construct validation conducted on 79 students outside the sample. The validation results can be seen in Table 3 and 4.

Table 3

Validity results of the Litc-Tsu Test instrument

No Item	Pearson	R table	Discussion	No Item	Pearson	R table	Discussion
1	.484**	0,287	Item Valid	31	.434**	0,287	Item Valid
2	.484**	0,287	Item Valid	32	.674**	0,287	Item Valid
3	.653**	0,287	Item Valid	33	0.022	0,287	Item No Valid
4	.394**	0,287	Item Valid	34	.292**	0,287	Item Valid

No Item	Pearson	R table	Discussion	No Item	Pearson	R table	Discussion
5	.541**	0,287	Item Valid	35	.510**	0,287	Item Valid
6	.422**	0,287	Item Valid	36	.293**	0,287	Item Valid
7	.630**	0,287	Item Valid	37	.334**	0,287	Item Valid
8	.355**	0,287	Item Valid	38	.360**	0,287	Item Valid
9	.380**	0,287	Item Valid	39	.416**	0,287	Item Valid
10	.593**	0,287	Item Valid	40	.366**	0,287	Item Valid
11	.291*	0,287	Item Valid	41	.289**	0,287	Item Valid
12	.292**	0,287	Item Valid	42	.387**	0,287	Item Valid
13	.321**	0,287	Item Valid	43	.341**	0,287	Item Valid
14	.486**	0,287	Item Valid	44	.374**	0,287	Item Valid
15	.599**	0,287	Item Valid	45	.387**	0,287	Item Valid
16	.398**	0,287	Item Valid	46	.437**	0,287	Item Valid
17	.373**	0,287	Item Valid	47	.326**	0,287	Item Valid
18	.505**	0,287	Item Valid	48	.292**	0,287	Item Valid
19	.432**	0,287	Item Valid	49	.538**	0,287	Item Valid
20	.420**	0,287	Item Valid	50	.578**	0,287	Item Valid
21	0.140	0,287	Item No Valid	51	.400**	0,287	Item Valid
22	0.104	0,287	Item No Valid	52	.377**	0,287	Item Valid
23	.705**	0,287	Item Valid	53	.432**	0,287	Item Valid
24	.314**	0,287	Item Valid	54	.451**	0,287	Item Valid
25	.505**	0,287	Item Valid	55	0.110	0,287	Item No Valid
26	.599**	0,287	Item Valid	56	.414**	0,287	Item Valid
27	.599**	0,287	Item Valid	57	-0.077	0,287	Item No Valid
28	.578**	0,287	Item Valid	58	.599**	0,287	Item Valid
29	.514**	0,287	Item Valid	59	.579**	0,287	Item Valid
30	.566**	0,287	Item Valid	60	.492**	0,287	Item Valid

Table 4

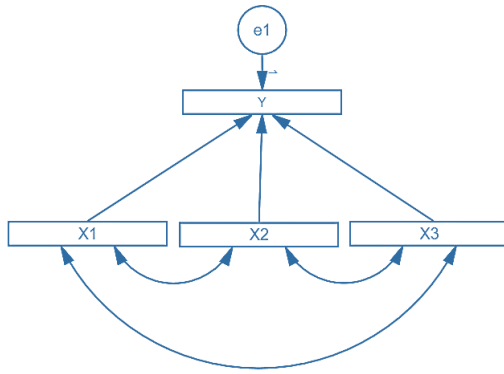
Reliability results of the Litc-Tsu Test instrument

Reliability Statistics	
Cronbach's Alpha	N of Items
.960	60

The information obtained was processed using AMOS and SPSS computer programs to test the relationship between social characteristics of the population and knowledge about tsunamis (Litic-Tsu, Y). The analysis method used follows the structural equation modeling (SEM) guidelines, as shown in Figure 1. In addition, an in-depth examination was carried out using analysis of variance (ANOVA) and the coefficient of determination (R^2) in SPSS to determine the exact contribution of the influencing factors and the influenced factors.

Figure 1

Testing model of X1, X2, and X3 on Y and their correlations



Note. Description: Gender (X1); Age (X2); Place of Residence (X3); Level of Tsunami Disaster Literacy (Y)

Structural Model Equation:

$$Y = \beta_1 + \beta_2 X_2 + \beta_3 X_3 + e_Y \quad \dots\dots\dots (1)$$

where:

- Y = endogenous variable (tsunami disaster literacy)
- X₁, X₂, X₃ = exogenous variables (gender, age, place of residence)
- β₁, β₂, β₃ = path coefficients
- e_Y = error term or residual

Covariance Matrix of Exogenous Variables

$$\Sigma X = \begin{bmatrix} Var(X_1) & Cov(X_1X_2) & Cov(X_1X_3) \\ Cov(X_2X_1) & Var(X_2) & Cov(X_2X_3) \\ Cov(X_3X_1) & Cov(X_3X_2) & Var(X_3) \end{bmatrix} \quad \dots\dots\dots (2)$$

Theoretical Variance of Y:

$$Var(Y) = \beta^T \Sigma X \beta + Var(e_Y) \quad \dots\dots\dots (3)$$

with:

$$\beta = \begin{pmatrix} \beta_1 \\ \beta_2 \\ \beta_3 \end{pmatrix}$$

General SEM Model:

$$y = \Gamma x + \Omega \quad \dots\dots\dots (4)$$

where:

- y = vector of endogenous variables
- x = vector of exogenous variables
- Γ = path coefficient matrix from x to y
- Ω = vector of residuals

To strengthen the robustness of the findings, we further conducted linear regression analysis and measured the specific contribution of each exogenous variable through the following formulations:

Linear Regression Model:

$$\text{General equation: } y = ax + b \quad \dots\dots\dots (5)$$

Coefficient of Determination (R²)

$$R^2 = \frac{[\sum_{i=1}^n (x_i - \bar{x})(y_i - \bar{y})]^2}{[\sum_{i=1}^n (x_i - \bar{x})^2][\sum_{i=1}^n (y_i - \bar{y})^2]} \quad \dots\dots\dots (6)$$

Through the criteria of 0 ≤ R² ≤ 1.

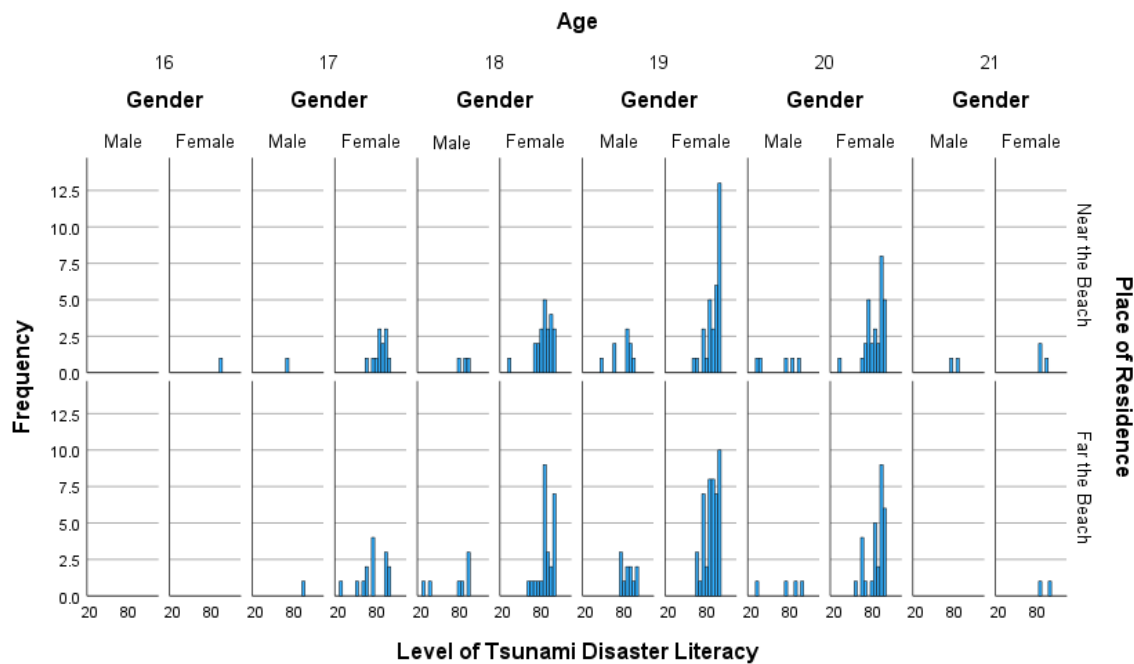
Results

General Result

Tsunami disaster literacy (Litc-Tsu) plays a critical role in disaster mitigation as it helps reduce the adverse impacts of risk (Fadilah et al., 2020). The descriptive survey results from 260 university students are presented in Figure 2.

Figure 2

Descriptive statistical analysis of X_1 , X_2 , X_3 , and Y



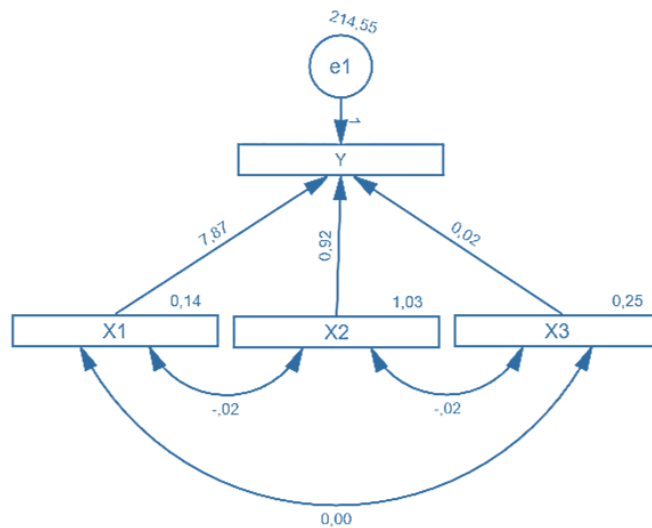
Note. Description: X_1 = Gender; X_2 = Age; X_3 = Place of Residence; Y = Tsunami Disaster Literacy Level

In summary, the results of the description show that knowledge about tsunamis (Litc-tsu) among students is generally quite high (with a scale of 20 being the lowest and 80 being the highest), and the data tends to peak on the right side. Although a few small groups show the opposite trend, the majority of students have a better level of knowledge. The following are the details of the main findings: (1) Based on gender, Female students tend to be more knowledgeable than male students; (2) In terms of age, Students aged 19 to 20, especially females, show better understanding than other age groups. However, these changes across age groups indicate that increasing age does not necessarily guarantee higher Litc-tsu, and (3) Students who live near the coast have a better understanding than those who live far inland.

Based on these findings, we can say that female students aged 19 to 20 who live near the sea have the highest Litc-Tsu scores. Conversely, female students aged 16 to 17 who live farther from the coast have the lowest scores. To reinforce these observations, we conducted a structural equation modeling (SEM) analysis using AMOS 29, which can be seen in Figure 3.

Figure 3

SEM model of the effects of X1, X2, and X3 on Y and their correlations



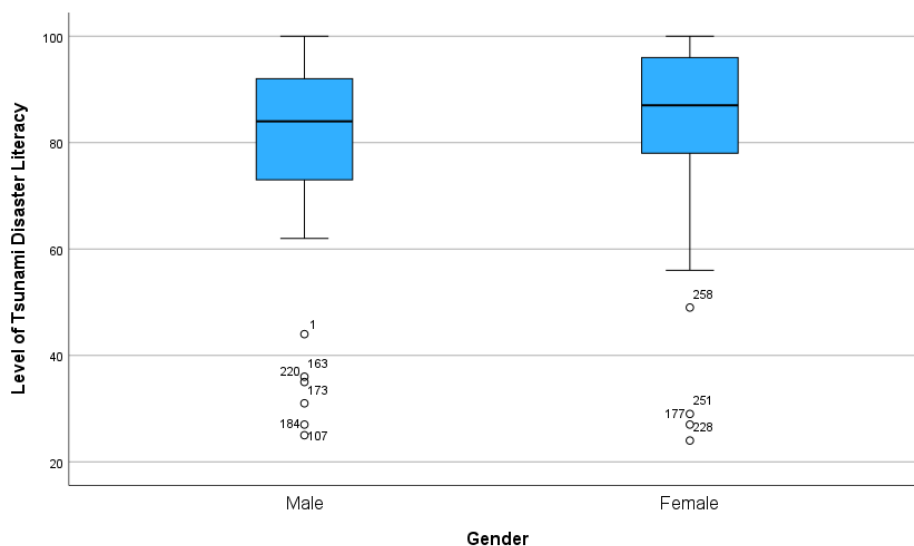
Note. Description: X₁ = Gender; X₂ = Age; X₃ = Place of Residence; Y = Tsunami Disaster Literacy Level

Based the results of structural equation modeling (SEM), it was found that gender was the only factor that had a significant impact on Litc-Tsu competence among students (CR value = 7.87), while the other two factors, age and geographical proximity of residence, had no significant impact, with CR values of 0.92 and 0.02, respectively. Furthermore, the relationship between independent variables did not show any strengthening; instead, it appeared to be very weak or even completely uncorrelated in the findings of this study. Through the margin value ($e = 214.55$), it can be assumed that the level of Litc-Tsu competence cannot be explained by only three variables, but there are other situational and psychological factors that have a greater impact. This becomes a gap in further research to be followed up in depth.

Gender and Tsunami Literacy (Litic-Tsu)

Figure 4

Distribution of tsunami literacy by gender



These distribution results illustrate that the female group demonstrated a deeper understanding and/or was categorized as higher than the male group among the 260 participants surveyed in the field. Not stopping there, we followed up our inferential analysis through ANOVA and R-squared testing with the following hypothesis:

Hypothesis testing: Gender is influential and correlated with Litc-Tsu levels, and female groups are more dominant in Litc-Tsu skills than male groups?

Results of inferential data processing:

Table 5

Linear regression analysis of gender and Litc-Tsu

ANOVA ^a					
Model	Sum of Squares	Df	Mean Square	F	Sig.
1					
Regression	2149.326	1	2149.326	9.901	0.002 ^b
Residual	56223.640	259	217.080		
Total	58372.966	260			
a. Dependent Variable: Level of Tsunami Disaster Literacy					
b. Predictors: (Constant), Gender					

Furthermore, the contribution of gender to tsunami literacy is presented in the following table.

Table 6

Contribution of gender to tsunami literacy

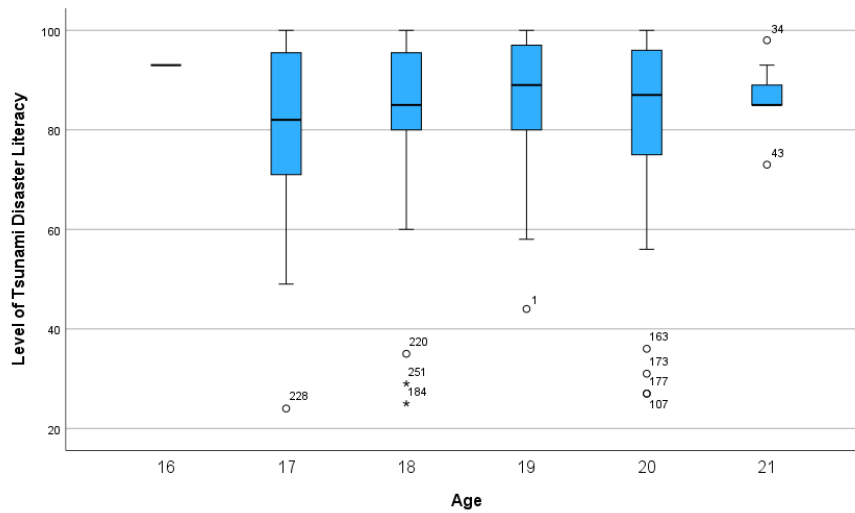
Model Summary ^b										
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				Sig. F Change	Durbin-Watson
					R Square Change	F	df1	df2		
1	0.192 ^a	0.037	0.033	14.734	0.037	9.901	1	259	0.002	1.925
a. Predictors: (Constant), Gender										
b. Dependent Variable: Level of Tsunami Disaster Literacy										

Regression results showed that gender significantly influenced tsunami literacy ($p = .002 < .05$), with an explanatory power of 3.7%, while other factors explained the remaining 96.3% of variance. Although the effect size is modest, the result confirms that gender has a measurable influence on students' disaster literacy.

Age and Tsunami Literacy (Litic-Tsu)

The results we found in this study show fluctuations in Litc-Tsu proficiency across each age interval. Starting from the age of 17 to 19, there was an increase, but after that there was a decline, although it was categorized as a slight decline. From this, we see that these findings reinforce the idea that age does not affect litc-tsu descriptively. To reinforce these results, we propose a hypothesis in this section:

Hypothesis testing: Does age affect and correlate with Litc-Tsu levels, and does age group interval affect their Litc-Tsu proficiency?

Figure 5*Distribution of tsunami literacy by age*

Results of inferential data processing:

Table 7*Linear regression analysis (age and Litc-Tsu)*

ANOVA ^a						
	Model	Sum of Squares	df	Mean Square	F	Sig.
1	Regression	160.241	1	160.241	0.713	0.399 ^b
	Residual	58212.725	259	224.760		
	Total	58372.966	260			
a. Dependent Variable: Level of Tsunami Disaster Literacy						
b. Predictors: (Constant), Age						

Then, how do the independent variables contribute to the dependent variables presented in Table 8.

Table 8*Contribution of age to tsunami literacy*

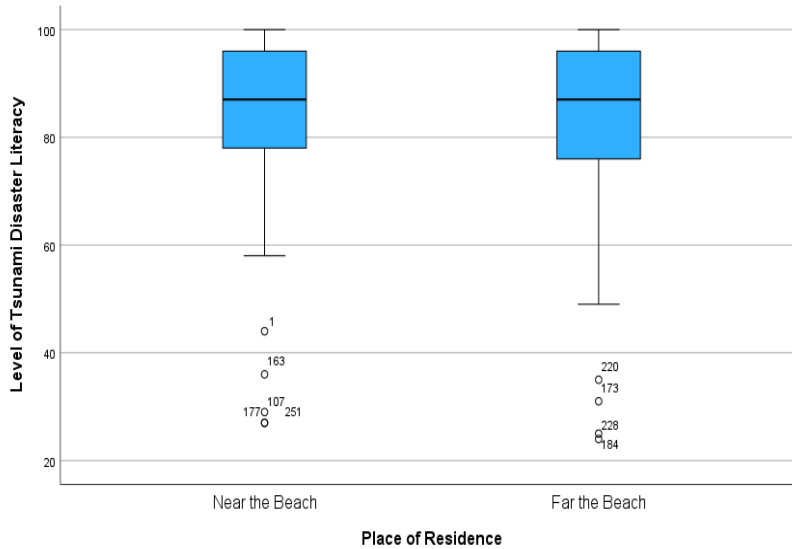
Model Summary ^b										
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	0.052 ^a	0.003	-0.001	14.992	0.003	0.713	1	259	0.399	1.988
a. Predictors: (Constant), Age										
b. Dependent Variable: Level of Tsunami Disaster Literacy										

Through the results of inferential ANOVA and R Squared, we can conclude that the age factor does not have a significant effect ($0.399 > 0.05$) and only contributes 0.3%, with the rest coming from other X factors.

Geographical Proximity to Hazard Zones and Litc-Tsu

Figure 6

Distribution of place of residence and Litc-Tsu



The final factor in this study found that the difference was only (0.12). The preliminary conclusion is that people who live near the coast have higher Litc-Tsu levels than those who live far from the coast. We confirmed this finding through inferential analysis to test the following hypothesis:

Hypothesis testing: Does the factor of geographical proximity of residence influence and correlate with the level of Litc-Tsu, and do regional differences in city levels affect Litc-Tsu patterns?

Table 9

Linear regression analysis (place of residence and Litc-Tsu)

ANOVA ^a					
Model	Sum of Squares	df	Mean Square	F	Sig.
1 Regression	0.254	1	0.254	0.001	0.973 ^b
Residual	58372.712	259	225.377		
Total	58372.966	260			

a. Dependent Variable: Level of Tsunami Disaster Literacy
b. Predictors: (Constant), Place of Residence

Then, the contribution between these two crossed variables is presented in Table 10.

Table 10

Contribution of place of residence to Litc-Tsu Capability

Model Summary ^b										
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change	Durbin-Watson
1	0.002 ^a	0.000	-0.004	15.013	0.000	0.001	1	259	0.973	1.971

a. Predictors: (Constant), Place of Residence
b. Dependent Variable: Level of Tsunami Disaster Literacy

The third result in this study is a unique finding. Although there is a difference of 0.12 in the scores between people who live near the coast and those who live far from the coast, this does not mean that there is a significant positive correlation. We found that there is no significant effect ($0.973 > 0.05$) and that the two variables are not even correlated, or in other words, the correlation is 0%.

Discussion

The youth group is a liaison group for disaster preparedness efforts for families and the surrounding community. Hall et al. (2022) agree with this statement in their study, mentioning that youth groups have a higher absorption capacity for knowledge, which can impact on disaster preparedness actions in their families through information exchange. Several studies support this, in understanding disaster mitigation, a person's perspective is very decisive because impacts the formation of their preparedness actions in decision-making during a disaster. However, if their perspective is wrong, it will result in slow action (Han et al., 2022; Martins & Nunes, 2024). This condition considers socio-demographic factors to be determining factors that can influence the level of litc-tsu among adolescents, but this consensus needs comprehensive empirical confirmation.

Gender Contribution to Litc-Tsu

This study reveals that gender factors have an influence and contribute to Litc-tsu skills among adolescents. These results are in line with previous studies that emphasize gender as a major factor in vulnerability and resilience during disasters (Aryanti & Muhlis, 2020; Hall et al., 2022; Seddighi et al., 2022; Vu et al., 2023; Go, 2024; Mardialina et al., 2024). Mızrak et al. (2021) demonstrated that gender is an important factor that not only influences risk perception but also determines how well people understand disasters, their preparedness, and their vulnerability to tsunami impacts.

Specifically, we found that the Litc-tsu level among women (52%) was higher than that among men (48%). In general, women tend to be more cautious about their safety and care about others. Therefore, this group is more likely to engage in safety procedures that shape their understanding of tsunami preparedness (Brown et al., 2021; Spence & Lachlan, 2011; Zhao et al., 2021). De Silva et al. (2021) mentioned that women often play a key role in conveying warning information to families and communities according to their needs in their study.

However, several studies reject these findings if men have higher disaster literacy than women (Hoffmann & Blecha, 2020; Yusuf et al., 2022). Khan et al. (2021) conducted an investigation of 486 students in Pakistan and found that male groups were better prepared to deal with disasters in emergency situations than female groups. We highlight that women may have a higher fear of certain disaster threats such as tsunamis, earthquakes, floods, landslides, volcanic eruptions, and strong winds (Hall, 2022; Parsons & Lykins, 2023).

They highlight that panic makes them more vulnerable and less alert in emergency situations (Sari & Ridhwan, 2022). It is no surprise that mortality rates are higher among women than men in disaster situations (Kantamaneni et al., 2022; Raheem et al., 2025; Zarook, 2022). Worse still, previous studies have mentioned that women are vulnerable to the long-term effects of disasters, such as a decline in their quality of life and life expectancy, trauma, and difficulties in post-disaster recovery (Fatouros & Capetola, 2021; Sedghi et al., 2025).

In response to this, there is a need for an early warning system that truly meets the needs, including considering gender aspects in the emphasis of the Sendai Framework for Disaster Risk Reduction (UN, 2015). In short, the development of disaster management regulations through education, especially with a focus on preparedness (Mızrak et al., 2021), must incorporate a gender perspective as input from this study so that the strategies developed are more inclusive, successful, and sustainable. It should be emphasized that although women have a satisfactory level of understanding, this is not reflected in their behavior or attitudes; that is, they are still prone to panic. Therefore, we

suggest that preparedness should not only be measured by how much they know but also by their attitudes through targeted socialization programs as a contribution to the findings of this study.

Age Contribution to Litc-Tsu

The results of the study show that understanding of tsunami disasters varies among individuals aged 17 to 21 years (This age is obtained from survey results). This is in line with previous assumptions that age is not the main determinant of tsunami disaster literacy (Litic-Tsu) abilities. In numerical terms, a significance level of 0.399 (greater than 0.05) suggests that age does not significantly affect students' Litc-Tsu abilities. In fact, age only accounts for 0.3%, while the remaining 99.7% is influenced by other, more significant factors. These findings strongly support previous findings such as those of Gülsoy et al. (2025) and Tohan et al. (2024), who agree that there is no correlation between age and Lit-tsu levels and that the older a person is, the less prepared they are to manage disasters. Cerase and Cugliari (2023) add that this relationship is not always proven.

Several previous studies have refuted this if age is a determining factor and has a correlation or influence on Litc-tsu (Genc et al., 2022; Hall et al., 2022; Jayasekara et al., 2023; Khairunnisa et al., 2021; Seddighi et al., 2022; Sun & Sun, 2019; Vu et al., 2023). Sun and Xue (2020) mention that age, educational background, and income together influence attitudes toward disasters, especially in terms of decisions to save oneself and how to view danger. In another context, Mızrak et al. (2021) report that the combination of age and schooling is very beneficial in predicting perceptions of disaster risk, especially among women during earthquakes.

These contrasting results show how complicated it is to view age as a determinant of disaster understanding and risk perception. We must also be aware that this study is limited because it only observed one age group, namely adolescents (17–21 years old), without researching children, adults, or the elderly. As a result, this research cannot provide a complete picture of how age differences can lead to different perspectives and coping strategies when facing the threat of a tsunami. These limitations and gaps provide input for future research and highlight the importance of these findings if it turns out that there are no significant differences between age groups (adolescents).

Place of Residence Contribution to Litc-Tsu

Descriptive analysis shows that students who live closer to the sea have slightly higher Tsunami Disaster Literacy (Litic-Tsu) scores than students who live further away. However, the difference is minimal, only 0.12 points, and there is no clear pattern. Inferentially, statistical tests reveal a significance value of 0.973 (greater than 0.05), which means that place of residence does not have a significant impact on students' Litc-Tsu abilities. The contribution of this variable is only 0.00 percent, indicating that although those who live closer to the sea have slightly higher scores (an average of 0.12), physical distance is not the main determinant of tsunami literacy. This is consistent with several studies, such as O'Neill et al. (2015), which found no correlation between the two variables.

Conversely, previous international research presents different findings. In Norway, Goeldner-Gianella et al. (2017) found that residents in disaster-prone areas showed greater concern and a more accurate understanding of evacuation times than non-local residents. Similarly, research in Chile indicates that people living in tsunami hazard zones report better preparedness than those living outside risk areas (Cisternas et al., 2024). Other researchers have linked proximity to an increased perception of risk, noting that shared memories of past disasters reinforce vigilance among coastal communities (Dhellemmes et al., 2021; Khairunnisa et al., 2021; Vu dkk., 2023; Wei et al., 2017). Arias et al. (2017) even argue that perceived risk decreases with increasing physical distance from the source of the threat. In addition, several studies highlight the close relationship between distance of residence and perceived disaster risk. Perceived risk tends to be higher among people who live near the coast (Dhellemmes et al., 2021; Sherman-Morris et al., 2025) and is shaped by time and collective memories of past disasters (Wei et al., 2017). Arias et al. (2017) further emphasize that proximity to the source of

danger has a positive impact on risk awareness, while perceived risk decreases as the distance from danger increases.

On the whole, although this study did not identify a statistically significant impact of place of residence on Litc-Tsu, small differences in average scores and strong support from previous research suggest that the psychological and social aspects of geographical proximity remain important. However, it should be noted that the proximity we refer to in this study is around the coastal area (approximately ± 1 km). This is a scientific contribution because, at the sub-district level alone, the influence of place of residence and tsunami literacy cannot be ascertained. We suggest that in the future, more specific research be conducted on the participants' places of residence, whether they are actually located on the coast or far from it.

Conclusion

This study provides new evidence for tsunami disaster literacy studies by showing that the impact of socio-demographic factors is not uniform. Of all the elements we studied, gender had the most noticeable influence, with female students demonstrating a better understanding of tsunamis, while age and distance to the sea had no statistically significant effect. The results of the study highlight the level of Litc-Tsu among students (adolescents) measured through more complex socio-demographic characteristics with comprehensive analysis, enabling the findings to contribute to the development of disaster mitigation strategies in the future.

We emphasize several socio-demographic factors that require a disaster education approach that takes gender differences into account. The study found that women play a key role in improving Litc-Tsu before a disaster, although the sample size was limited to adolescents. In addition, age and geographical proximity yielded different findings. We assume that the significance of the age factor cannot be measured in a single group but that children, adults, and the elderly need to be investigated further and that the factor of geographical proximity of residence also needs to be examined specifically, for example, the application of coastal corridors to Litc-Tsu levels. Some of these results greatly support strategies to increase Litc-Tsu in the face of potential disasters, especially among adolescents.

Limitation

This study has limitations, such as the age group measured being limited to teenagers (17–21 years old) and the factor of geographical proximity to the coast not being measured using the coastal corridor principle (± 1 km from the coast) but rather measured by area or city level. Essentially, this measurement was conducted to identify Generation Z (teenagers) and their knowledge of tsunamis.

Suggestion

Based on the limitations we mentioned earlier, we recommend the following:

- 1) Measurements should be taken not only in one group, but in several groups to obtain more specific results.
- 2) The geographical proximity of residences should be limited to coastal corridors (± 1 km from the coast), as this will also yield more specific results.
- 3) We obtained Litc-Tsu levels based on gender, which serves as the basis for further research to address their Litc-Tsu deficiencies through science communication tactics in transforming virtual reality within the metaverse environment. This aims to enhance their mindset toward tsunami simulations and foster awareness of the dangers they face (Gargiulo et al., 2025).

Acknowledgements

We are grateful for the financial support for this research from the Ministry of Higher Education, Science, and Technology of the Republic of Indonesia, through the BIMA grant program under the Regular Fundamental Research scheme, with research contract number 076/C3/DT.05.00/PL/2025.

Declaration of Interest

No conflict of interest

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