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EARTHQUAKE RISK PERCEPTION IN BANJA LUKA: IMPLICATION FOR SEISMIC MANAGEMENT

Vesna Šipka [(1)], Mirjana Landika [(2)], Ljiljana Popović [(3)]

[(1)] *DRR and planning expert, Department for Civil Protection, City of Banja Luka, BiH,vesna_sipka@hotmail.com*
[(2)] *Full Professor, Panevropean University Banja Luka, BiH, mirjana.landika@gmail.com*
[(3)]*Ass.Professor, Faculty of Technical Sciencies, University of Novi Sad, ljiljana.popovic.ns@gmail.com*

Abstract

Seismic risk perception can be considered as critical factor related to citizens behavior during earthquake public risk perceptions had been surveyed in Banja Luka, one of the most earthquake prone risk exposed city in Bosnia and Hercegovina. This study aims to identify various factors influencing people's perceptions of earthquake risk.

This paper presents quantitative research results regarding the influence of socio-demographic factors on the earthquake risk perception of the citizens of Banja Luka. The aim of the research is to determine how much the citizens of Banjaluka are aware of the risk and prepared to react in the event of an earthquake. The relationship between gender, age, level of education, facility ownership and other factors with risk perception have been examined. T-test, Mann Whitney U test, and Pearson correlation coefficient were used to examine the relationship between the variables and the earthquake risk perception.

The questionnaire consists of 16 questions. The first part of the questionnaire was consisted of general questions about the socio-demographic characteristics of the respondents as well as questions in regards to past experience and attitude to earthquakes. The second part of questionnaire consists questions that would determine the level of awareness of the respondents about earthquakes, and the questions for determining the respondents preparedness. Using the snowball sampling technique (online questionnaire) the survey was conducted during August 2024 (N= 415 respondents)

Keywords: disasters, earthquake, risk perception, management, preparedness

1. Introduction

It is widely known that earthquake damage is influenced not only by earthquake parameters, building vulnerability, local soil conditions, and deep geology but also human behavior and actions before, during, and after earthquakes. Resilience, both community and individual, may have a significant impact on level of damage as well as recovery.

Risk is combination at least three variables hazard, exposure and vulnerability. Reducing any of these parameters also diminishes the risk. Understanding that seismic risk hazard cannot be decreased and very often there is no possibility to take any action related to exposures. The only window for certain actions is vulnerability, both material as well as non-material. Non-material resilience might be described as knowledge and preparedness for appropriate actions before, during and after earthquake.

The literature on risk reduction highlights the critical roles that education, families, and the community play in fostering a culture of preparedness and disaster recovery [1]. Risk perception might be important determinant of the behaviour towards risks, e.g. for the decision to take preventive measures. If risk perception and influencing factors of people living in risk prone areas is known, effective information strategies on protective measures can be designed [2]. According to [3] 86 out of 100 Italian citizens, living in the most dangerous zone, do not have a correct perception of seismic hazards. Citizens have scattered ideas and incomplete information regarding risk topic and the civil protection authority (via internet) was the primary source of information [1].

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Earthquakes can result in severe consequences for human communities, infrastructure, and the natural surroundings. Data from the Centre for Research on the Epidemiology of Disasters (CRED) show that earthquakes caused the most widespread devastation, accounting for 58% of total fatalities in natural disasters from 2000 to 2019. Mitigating seismic risks is a diverse process, but it always starts with a precise assessment of seismic hazards [4] but also recognizing interested and affected citizens as legitimate partners in the exercise of risk assessment is not a short-term solution for the challenges of risk management. However, serious attention to participation and process issues may, in the long run, lead to more effective and satisfying ways to manage risk [5].

Numerous global studies have been conducted on the perception of seismic risk; however, local researchers have yet to undertake any investigations in Bosnia and Herzegovina. Researchers in this area have demonstrated a lack of interest in this subject, despite the fact that our country, along with the entire Balkan Peninsula, is seismically active. The seismic activity observed in this region is a result of the subduction of the Adriatic microplate beneath the Eurasian plate. Residents of Banja Luka are at risk from earthquakes originating in the local seismogenic zone, as well as the potential impact of seismic activity in nearby regions. Due to its geographical position, Banja Luka is vulnerable to earthquakes originating from Croatia, which is also a seismically active region.

The 2020 Petrinja earthquake revealed that Banja Luka's citizens, public administration, and institutions lack the knowledge and readiness necessary to withstand even moderate ground shaking. Even when decision-makers are aware of past earthquakes that have resulted in natural disasters in their regions, it can be highly challenging to alert them to the seismic risk issue. Light damage was reported in 85 flats to the local civil protection.

No studies have specifically addressed the population's perception of seismic risk in Banja Luka. However, research focusing on the perception of seismic risk among students in the final years of primary and lower secondary education was conducted as part of a master's thesis [6]. Data for this study were gathered through a closed-ended questionnaire. A total of 812 students from 13 schools participated. The first part of the questionnaire consisted of 5 questions related to knowledge and attitudes towards earthquakes and seismic risk, while the second group of 5 questions evaluated preparedness for earthquake response.

The findings concerning the training and readiness of students are particularly concerning. Just over half of the students indicated that they are familiar with the procedures to follow during and after an earthquake, as well as the designated evacuation routes. Notably, only 40% of the respondents reported having attended lectures on earthquake safety. Furthermore, the participation rate in practical earthquake drills is alarmingly low, with only 19% of students affirming their involvement.

This study aimed to investigate how citizens of Banja Luka perceive seismic risk, despite the lack of data related to building vulnerability and other risk elements. Additionally, the authors intended to analyze the results to draw conclusions about the level of preparedness and knowledge of safety protocols in case of an earthquake. An indicator of trust in the civil protection service can be derived from the responses regarding the source of information about earthquake protection.

The hypothesis is that a significant percentage of Banja Luka's residents perceive seismic risk as high, meaning they are aware of the danger of potential earthquakes. The fear of earthquakes, due to memories of the devastating earthquake, is also strong among many citizens. On the other hand, the level of preparedness, expressed through knowledge of procedures in case of an earthquake, does not match the perceived risk or fear of earthquakes. Statistical analysis of the data will investigate the impact of the respondents' socio-demographic characteristics on the perception of seismic risk.

In this respect, this paper could be considered as the pioneering study of seismic risk perception in Bosnia and Herzegovina, particularly focusing on Banja Luka as one of the most seismically prone city. The aim of this paper is to elaborate on seismic risk perception of populations in a remarkably seismic-prone area of Bosnia and Herzegovina: the Banja Luka area.

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To understand citizens' perception of seismic risk, we analyze psychometric components: (a) awareness of risk, (b) fear, (c) attitude toward the possibility of earthquake protection, and (d) knowledge of safety protocols. This methodology, combined with an assessment of personal traits, might offer comprehensive insight into how individuals perceive earthquake risks and potentially reveal vulnerable populations. By identifying areas of weakness and potential for enhancing community resilience, civil protection authorities can develop focused strategies and policies aimed at fostering a safer and more resilient environment. This study aimed to offer valuable insights into community resilience, thereby assisting decision-makers in strengthening it through strategic initiatives.

Seismic risk assessment requires reliable hazard and vulnerability assessment studies, such studies are inadequate in number in developing countries. In the absence of solid data to accomplish seismic risk assessment, risk perception (perceived risk) may be a good replacement for working out risk reduction measures. This study will be highly helpful for administrative staff, disaster management authorities, and local governments to plan efficient risk reduction policies in the future for disaster risk reduction, particularly in earthquake-prone areas [7].

The paper is organized as follows: Section 1 reviews the literature on seismic risk perception; Section 2 describes the methodology used; Section 3 presents the results; Section 4 discusses the findings and implications; and Section 5 concludes with recommendations for future research.

1.1. Literacy review

The literature review aimed to investigate the similarities and differences in the perception of seismic risk among various societies and its correlation with individual resilience. To accomplish this objective, the authors examined scientific literature concerning seismic risk perceptions and related subjects pertinent to European cities and countries, in addition to Indonesia, Mexico, the USA, Australia, and other regions worldwide. The authors attempted to include not only research for geographically diverse locations but also to cover cities/countries with different levels of seismic hazard and prior earthquake experience.

Social vulnerability is as much a part of risk as building damage, hazard magnitude, and economic loss [8]. By integrating social vulnerability analysis and socio-psychological factors into disaster management, efforts can more effectively prevent, reduce, and respond to the diverse challenges posed by earthquakes [9], [10], [11].

Risk perception is a fundamental element in the definition and adoption of preventive counter-measures [3]. “Risk is the socially constructed sum of hazard and public perceptions” [5]. Risk perception refers to people's judgments and evaluations of hazards they (or their facilities, or environments) are or might be exposed to. Risk attitudes are people's intentions to evaluate a risk situation in a favorable or unfavorable way and to act accordingly [9]. Awareness and perception of risk are among the most crucial steps in the process of taking precautions at individual level for various hazards [12]. Integrating public perception into the decision-making process might bridge the gap between scientific expertise and community values. It can increase the transparency and responsiveness of policy decisions, making them more inclusive and better aligned with the public's needs and concern [13]. A large proportion of people the world over do nothing or very little to adjust to seismic hazards [11]. Some studies have identified fatalistic attitudes, with respondents considering natural disasters as inevitable events [14],[13],[15],[16],[17],[18].

Risk perception studies have identified various determinants that influence individuals’ behaviors and attitudes, The impact of the determinants may be positive and negative. The most commonly examined determinants fall into the following interlinked categories: psychometric, demographic, and socioeconomic [19], [15]. Gender is strongly related to risk judgments and attitudes [5],[8],[20]. Several dozens of studies have documented the finding that men tend to judge risks as smaller and less problematic than do women [5],[20],[19],[15],[22],[23],[24]. On a regular bases the following risk perception determinants were elaborated age, education [20], [19], [21], [15],[12] [22],[23],[24],[18]. Earthquake risk perception varied significantly according to income levels [19], [21],[18]. Previous

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earthquake experience also show some impact on seismic risk [21]. Some researches have focus on risk awareneses [25],[26], [23], [27], emphase influence of household structure [12], [28], [24]. Studies conducted in cities that have previously experienced damaging earthquakes reveal that the participants lack a seismic risk prevention culture [29], [24], [18].

The explicit recognition within disaster risk reduction (DRR) activities that socio-psychological factors contribute to human vulnerability can improve the effectiveness of these activities in increasing seismic adjustments in individuals and small groups. Such DRR activities might include [11]. The the serious lack of emergency training perceived, both for adults and children [15], [25], [26], [30].

A region-specific strategy that considers the distinct socio-cultural characteristics of each locality is crucial, rather than implementing a one-size-fits-all methodology to improve resilience**.** The conclusion of the study [31] in this regards is that societies have diverse risk perceptions depending on local framework and cicumstances. Regular community drills, targeted educational campaigns, and the integration of disaster preparedness content into school curricula, have been highlighted as actionable steps to increase public awareness and community resilience [30].

Researchers predominantly assess vulnerability across various structural elements, reflecting a holistic approach to understanding and mitigating the impact of earthquakes on infrastructure and communities [4]. The review found a risk perception paradox related to linkage among risk perception and the likelihood of individuals to take preparedness actions. It is commonly assumed that high risk perception will lead to personal preparedness and, subsequently, to risk mitigation behavior. However, this is not necessarily true. In fact, the opposite can occur if individuals with high risk perception still choose not to prepare themselves personally in the face of a natural hazard [32].

In the absence of solid data for measuring the seismic vulnerability of buildings, risk perception can serve as a valuable proxy for developing earthquake risk reduction strategies [7].Disaster management which used to be more focused on emergency situations needs to be diverted to activities and capacity building [10].

The literature also recognise diverse leading source of information among the respondents such as media that could play an effective role in earthquake preparedness, especially if they act in a more responsive manner [12]. Communication seismic risk in diverse phases of risk management which involves providing technical and scientific information as a priority highlights a dozen of study. Finally, we suggest that further research should be undertaken about the optimal ways of communicating information and their roles in risk perception. [12], [33], [25]. Evidently risk communication is the indispensable link between risk perception and risk management [8]. It is necessary to improve public knowledge about measures for mitigation of damage and preparedness. The results indicate that future preparedness programmes should target people with lower level of risk perception and preparedness.

2. Methodology

The quantitative research aims to examine the influence of socio-demographic factors on the perception of earthquake risk among citizens in Banja Luka and its surrounding areas, and evaluate their preparedness. Given that Banja Luka and surrounding areas are the one of the most seismically active areas in Bosnia and Herzegovina and wider, this research aims to determine how much the citizens of Banja Luka are aware of the risk of earthquakes and how prepared they are to react in the event of an earthquake. The relationship between gender, age, level of education, and facility ownership and some other factors with risk perception were examined.

The paper is based on the central hypothesis that a large percentage of citizens in the study area perceive the seismic risk in Banja Luka as high and experience fear of earthquakes. However, their knowledge about earthquake safety protocols does not align with their perception of the risk. An online survey comprising a questionnaire with 16 closed-ended questions was conducted to evaluate citizens' attitudes and knowledge about seismic risk and protection from earthquakes. The questionnaire was available online from August 9 to September 5, 2024. In total, 415 responses were obtained.

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2.1. Sample

For the purposes of this research, adult citizens of Banja Luka and its vicinity were surveyed, and 415 answers were collected. There was a higher percentage of women (65.5%) than men (34.5%), and the most significant percentage of respondents were in the age group 31-45 years. The percentage of respondents from the group 46-60 years is slightly lower at 33.5%, while the lowest percentage (4.6%) is from the age group of over 60 years. The sample has 13.5% of respondents aged 18-30. The majority of respondents in the sample have higher education, followed by those who have completed high school. The percentage of respondents who have completed postgraduate studies is as follows: master's 12.5%, doctoral 1.4%. The most of respondents are married, 64.1%, followed by single respondents, 25.3%, as well as 8% divorced and 2.7% widowed respondents. The most significant percentage of respondents (50.8%) live in family-owned apartment, 38.3% of the respondents live in its own house and the smallest number of respondents live in a rented building (10.8%).

2.2. Questionnaire Design

The instrument used in the conducted research project was a survey questionnaire, consisting of 16 questions divided into two sections:

- General questions
- Specific questions

The general questions define the personal profile of the respondents and include personal information that may indicate the need for a sense of security, such as gender, age, marital status, educational background, monthly income, place of residence, and type of housing unit.

The specific questions relate to information about natural disasters and the respondents' attitudes towards them. Those questions provide input for assessment of responder's earthquake risk perception and preparedness. Since there is no national papers related to this topic, an examination of international scientific studies that employed questionnaires as research instruments was carried out to refine and develop the questionnaire required for this study.The final questionnaire was crafted using simple language, steering clear of any technical terminology. The questions in the questionnaire were answered by choosing the offered answer.

2.3. Analyses

The data collected from the survey were processed using the statistical software SPSS (Statistical Package for the Social Sciences). In order to eliminate possible errors when entering the answer, the data check was performed. The gathered data were then analyzed using descriptive statistics, and the frequency and percentage were determined. The next step involved comparing the collected data, namely the respondents' demographic traits and their perception of risk, such as the relationship between respondents' educational attainment and knowing safety measures and procedures for earthquakes. The relationship between the variables and earthquake risk perception was examined using a T-test and Mann Whitney U test. The Pearson correlation coefficient has been used for analyzing relationship for different sociodemographic variables. All tests were two-tailed, with a significance level of $p < 0.05$ and $p<0.01$. Statistical analysis was performed using SPSS Statistic 20.0 (IBM SPSS Statistics, New York, United States).

3. Results

With the aim to determine the level of awareness about earthquakes, the first question that have been asked was: " Do you believe that the risk of earthquakes occurring in Banja Luka is high? The most significant percentage of respondents answered affirmatively to this question (68.2%), but 22.9% of respondents answered that they were not sure and 8.9% respondents answered negatively. Regarding previous experience with natural disasters (such as floods, earthquakes, and storms), 52.8% of respondents reported having such experience, while 47.2% answered negatively. Additionally, in response to the question, "What is the source of information about earthquake protection?", 32.8% of

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respondents selected education, 35.7% od decided on the internet, 7.5% chose television, and 24.1% recognized the civil protection service as a source of information related to earthquake safety measures.

Table 1. Responders' attitudes related to earthquake risk perception

	Yes (%)	No (%)	Not sure (%)
Perception of the Banja Luka seismic risk –high	68.2	8.9	22.9
Belief of earthquake protection possibility	43.5	19.3	36.9
Feeling fear of earthquake	65.1	34.9	-
Knowledge of safety protocols	50.6	9.4	40.0
Knowledge of emergency service numbers	81.2	6.7	12.0

The hypothetical framework of the research includes illuminating the following facts: The high percentage of the citizens perceives the seismic risk in Banja Luka as high, but they do not believe that there is a possibility of protection against eartquakes. As a consequence, the level of preparedness in terms of knowledge of earthquake safety protocols is insufficient.

Responder's perception onseismic risk as well as attitudes toward the possibility for earthquake protection are shaped by past experiences, individual characteristics, and knowledge of safety protocols. The examination is conducted using relevant methods of statistical analysis, as follows. The percentage of respondents who believe that the risk in Banja Luka is high and that earthquake protection is possible can be determined using the T-test.

Table 2. Result of T-test related to risk peception in Banja Luka

a) One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
Do you think that the earthquake risk in Banja Luka is high?	415	1.55	.841	.041

b) One-Sample Test

	Test Value = 1					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Do you think that the earthquake risk in Banja Luka is high?	13.249	414	.000	.547	.47	.63

The T-test results reveal that 71%-74 % of residents believe that the seismic risk in Banja Luka is high This confirms the fact that citizens are aware that the likelihood of an earthquake occurring in the Banja Luka region is high but there is only 43.5 % responders beliving that earthquake protection is posible. The percentage of repsponders who think negative is 19.3% and significant number 36.9% is not sure about this topic. It means that they do not have information or do not think about this issue at all. The next T-test results reveal there is no correlation between between respondents who perceive the risk as high and the answers to the question about the possibility of protection against earthquakes.

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Table 3. Outcome of T-test, relationship between recognizing earthquake risk and protective measures

a) Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Do you think that the earthquake risk in Banja Luka is high?	1.55	415	.841	.041
	Do you believe that protection against earthquakes is possible?	1.93	415	.897	.044

b) Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	Do you think that the earthquake risk in Banja Luka is high? & Do you believe that protection against earthquakes is possible?	415	-.052	.294

c) Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Do you think that the earthquake risk in Banja Luka is high? & Do you believe that protection against earthquakes is possible?	-.383	1.261	.062	-.505	-.261	-6.191	414	.000

The survey results indicate that there is a low correlation between the two variables (risk perception and the potential for earthquake protection) at the 95% significance level (0.052). Furthermore, attitudes regarding earthquake protection are influenced by other factors, such as information and knowledge, fatalistic beliefs, and memories of past earthquakes.

The T-test results show no statistically significant difference according to gender in relation to earthquake risk perception and perception of preparedness. Also, Pearson correlation test results between determinants and variables regarding earthquake risk did not reveal any correlation.

The outcomes of the independent samples Mann Whitney U test indicate that gender is the most statistically significant; there is a statistically significant difference between gender and perception of seismic risk and related questions (Table 4).

Table 4. Results test Independent amples Mann Whitney U test

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Gender	
Question	Sig.*
Perception of the Banja Luka seismic risk –high	.012
Belief of earthquake protection possibility	.000
Feeling fear of earthquake	.000
Knowledge of safety protocols	.001
Knowledge of emergency service numbers	.042

*The significance level .05

4. Discussion

The assessment of how socio-demographic factors influence perceptions of seismic risk, as well as attitudes and knowledge regarding earthquake protection, is crucial for effective Disaster Risk Reduction (DRR) activities. These activities include enhancing public awareness, addressing and reducing fatalistic attitudes, increasing the level of individual preparedness, and improving the overall resilience of communities [11]. The high percentage of the citizens perceives the seismic risk in Banja Luka as high, but their belief about potential earthquake protection is not positive. As a consequence, the level of preparedness, in terms of knowledge of earthquake safety protocols, is unsatisfactory.

One possible explanation for this phenomenon is that residents retain memories of the 1969 earthquake, which heightens their perception of risk due to their awareness of the seismic activity in the region. Conversely, the extensive devastation experienced by the city may foster a fatalistic mindset, leading individuals to believe that effective protection against such disasters is unattainable. An analysis of the responses regarding awareness of earthquake response procedures reveals that 50.6% of participants claim to possess knowledge of these protocols, while the remaining respondents either lack knowledge or express uncertainty about their understanding. This uncertainty regarding the appropriate actions to take during an earthquake suggests a significant gap in familiarity with established safety protocols.

This indicates that a significant percentage of the population lacks confidence in their knowledge of earthquake safety measures, which could imply a need for better education and awareness programs about how to act during such events.

Table 5. The distribution responds on the question related to knowledge of safety protocols

Are you familiar with safety protocols in case of an earthquake?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	210	50.6	50.6	50.6
	no	39	9.4	9.4	60.0
	I am not sure	166	40.0	40.0	100.0
	Total	415	100.0	100.0	

These findings are in line with the observed risk perception paradox [32], which reflects that individuals with a perception of high risk still choose not to personally prepare for facing natural hazards. There are three possible reasons according to [32], providing for daily life needs is mentally more important than the perception of natural hazard risks; the influence of trust in the government and public services—both ways; confusion or ignorance about adequate safety protocols.

Considering the historical and political context of the studying region, the authors believe that all the previously mentioned factors are valid. The residents of the surveyed area retain vivid memories of

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wartime devastation and currently experience political instability, alongside the underlying risk of renewed conflict. In conjunction with a challenging economic landscape, it becomes increasingly difficult to encourage the populace to focus on natural disasters, particularly earthquakes, which occur infrequently. The experience of living in a transitional society marked by elevated levels of corruption diminishes the community's confidence in governmental institutions and services, including those related to the management of natural disaster risks. In Montenegro only 37.5% responders reported awareness of basic earthquake response procedures [30].

One of the most consistent findings from research on people's perception of risk is impact of gender, women tend to perceive higher level of risk. The educational attainment of the respondents does not influence this disparity [34]. This research indicated a significant correlation between gender and perceptions of seismic risk in Banja Luka which is consistent with a large number of studies [5], [36], [20], [21], [24] but also reveal larger the level of uncertainty regarding the potential for earthquake protection when compared to male respondents (Figure 1). One potential reason could be a lack of information regarding available protection options, or it could be that women often feel more vulnerable in emergency situations.

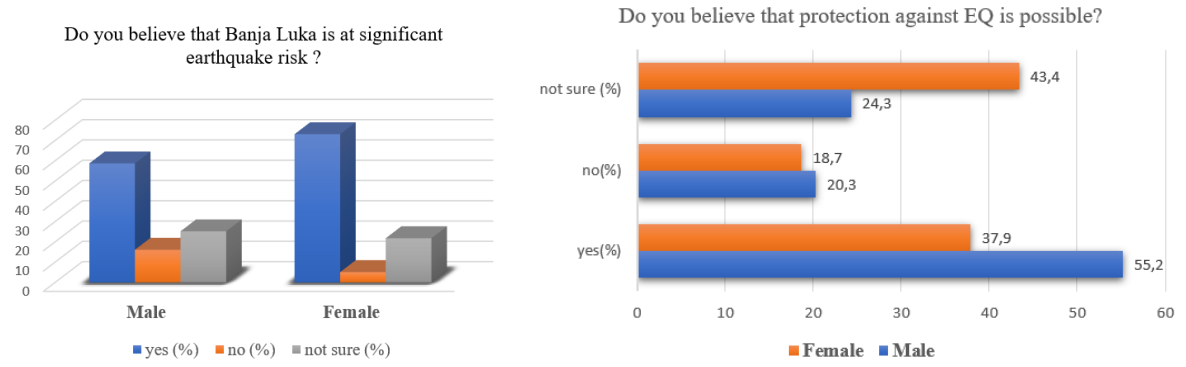

Figure 1. Differences in earthquake risk perception and belief in possibility protection between male and female responders

Besides this, the results further indicate that gender may play a crucial role in shaping attitudes towards familiarity with earthquake safety procedures, and awareness of emergency service contact numbers (Table 5). Other socio-demographic factors such as age, education, montly income, housing do not recognized as statisticall significant factor in seismic risk perception. The findings of study [37] stand in contrast, indicating that at a statistical significance level of 5%, factors such as age, educational attainment, marital status, property ownership, and household income exert an influence. Additionally, study [18] corroborates the effect of age and income, while study [24] demonstrates the impact of the age and housing. The same is with the study [21] revealing that income, and education level also have direct effects on how residents perceive of the risk from an earthquake. Considering that these studies were carried out in Serbia, Pakistan, Myanmar, and China, the observed discrepancies may be attributed to the larger geographical areas involved, which can influence the diversity of the respondents.

The marital status of the respondents indicates a statistically significant difference in only two areas: the perception of earthquake risk in the Banja Luka region and the fear of earthquakes. Additionally, the source of information regarding protective measures demonstrated a statistical correlation with both age and educational level, consistent with the findings of study [38].

The Department of Civil Protection is not highly ranked as a source of information, with only 24.1% of citizens choosing it. This result aligns with a survey in Italy [3] and may indicate a low level of trust or that civil protection is not sufficiently visible on the internet, which is the most frequently chosen source of information related to earthquake safety measures. The fact that only 7.5% of respondents chose television as a source of information can be explained by the lack of DRR contents on TV at all.

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The research conducted is constrained by its focus on a limited geographical scope, the area of Banja Luka. Additionally, electronic surveying method applied in this research has its drawbacks.

The next research will focus on the perception of seismic risk among teaching staff in all educational institutions in the City of Banja Luka. This focus is motivated by findings from a prior study, which revealed an inadequate level of preparedness within primary and secondary schools

The significance of this study lies in the fact that it is a pioneering project not only in the local community but also in Republic Srpska/Bosnia and Herzegovina. Given that this is Banja Luka is earthquake prone city, it is essential to gather data regarding the risk perceptions pf its residents as well as their attitudes and level of preparedness to earthquake.

5. Conclusion

Banja Luka is highly vulnerable to earthquakes. This paper presents findings on the seismic-risk perception and awareness among its residents. The respondents perceive the risks as high but have insufficient knowledge about the appropriate actions related to earthquake protection. According to the survey results, public awareness of seismic risk and mitigation is poor, and citizens' understanding of basic concepts and emergency response needs significant improvement. Reducing damage and increasing preparedness begins with proper and adequate communication of seismic risk to the population. For communication, knowledge of citizens' attitudes is essential. The results show that a considerable challenge to earthquake preparedness exists because of the disparity between the public's awareness of risk and their level of actual preparedness, which is in line with the findings of study [25].

The high percentage of the citizens perceives the seismic risk in Banja Luka as high, but their belief about potential earthquake protection is not positive. As a consequence, the level of preparedness in terms of knowledge of earthquake safety protocols is unsatisfactory. These results confirm the main hypothesis.

This research indicated a significant correlation between gender and perceptions of seismic risk in Banja Luka, in terms of that women mostly perceive risk as high. Other socio-demographic factors such as age, education, monthly income, and housing are not recognized as statistically significant factors in seismic risk perception. The research indicates that, in addition to the disparity between awareness of earthquake hazard exposure and the corresponding level of preparedness, Civil Protection is inadequately represented as an information source. It is necessary for Civil Protection to change its approach and media in communicating risks with the population. Evidently, risk communication is the indispensable link between risk perception and risk management [9]. Additional research and studies are necessary to better identify the risk factors, which will enable the formulation of valuable recommendations for effective risk communication. Researching the perception of seismic risk among people engaged in professions such as educators, first responders, etc., can be useful for creating tailored strategies.

Research of this nature, which focuses on the knowledge and preparedness levels of the population, is becoming increasingly important since there was no seismological research conducted in Banja Luka since 1971, nor analysis of the vulnerability of the housing stock.

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