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Measuring Gender-Based Risk Perception in Multi-Hazard Areas of Pakistan

Medición de la percepción del riesgo basada en el género en áreas de riesgo múltiple de Pakistán

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Abstract

The elementary step to tackling disaster risk is to understand the risk perception of inhabitants, which might assist in determining how likely someone is to prepare for calamities. Risk perception is considered a vital agent for the preparedness strategies of disaster risk reduction. The most vital requirement of multi-hazard areas is to improve management strategies based on the risk perception of inhabitants. This study aims to assess how university students perceive risk in the multi-hazardous area of Muzaffarabad in Pakistan. The components used to measure risk perception were fear, awareness, behavior, and trust. A detailed review of the literature was used to identify the indicators, and an index-based method was used to calculate the overall risk perception. A structured survey method was used to collect data on the students' perceptions based on gender. Chi-square and Student's t-tests were used to determine how male and female students perceive the risk of different hazards. The results have shown that university students have different perceptions of risk regarding hazards. The study indicates that gender-specific disaster risk management techniques are crucial for effective and inclusive response and readiness strategies among male and female students in multi-hazard locations.

Keywords: Risk Perception; Gender Differences; Disaster Risk Reduction; Multi-Hazard Areas; University Students; Muzaffarabad; Pakistan.

Resumen

El paso elemental para enfrentar el riesgo de desastres es comprender la percepción de riesgo de los habitantes, lo que podría ayudar a determinar la probabilidad de que alguien se prepare para las calamidades. La percepción del riesgo se considera un agente vital para las estrategias de preparación para la reducción del riesgo de desastres. El requisito más vital de las áreas de riesgo múltiple es mejorar las estrategias de manejo basadas en la percepción de riesgo de los habitantes. Este estudio tiene como objetivo evaluar cómo los estudiantes universitarios perciben el riesgo en el área multipeligrosa de Muzaffarabad en Pakistán. Los componentes utilizados para medir la percepción del riesgo fueron el miedo, la conciencia, el comportamiento y la confianza. Para identificar los indicadores se utilizó una revisión detallada de la literatura y se utilizó un método basado en índices para calcular la percepción general del riesgo. Se utilizó un método de encuesta estructurada para recopilar datos sobre las percepciones de los estudiantes en función del género. Se utilizaron las pruebas de Chi-cuadrado y t de Student para determinar cómo los estudiantes hombres y mujeres perciben el riesgo de diferentes peligros. Los resultados han demostrado que los estudiantes universitarios tienen diferentes percepciones del riesgo con respecto a los peligros. El estudio indica que las técnicas de gestión del riesgo de desastres específicas de género son cruciales para una respuesta eficaz e inclusiva y estrategias de preparación entre los estudiantes de ambos sexos en lugares con múltiples amenazas.

Palabras claves: Percepción de Riesgo; diferencias de género; Reducción del Riesgo de Desastres; Zonas de riesgo múltiple; Estudiantes Universitarios; Muzaffarabad; Pakistán.

Introduction

Risk is the probability that an event or activity will result in a negative outcome. It can be characterized as the uncertainty surrounding the outcomes of an incident and the possibility of an unfortunate event, representing the chance of suffering a loss (Rohrmann, 2008). There appears to be a general consensus that the likelihood of a negative event and the severity of its effects constitute the essence of risk, regardless of the context in which it is discussed (Short, 1984; Rayner & Cantor, 1987). Risk perception entails a specific assessment of the likelihood of an accident occurring and our level of concern for its consequences. This involves evaluating both the probability of an adverse outcome and the potential repercussions (Alnifie & Kim, 2023). Additionally, it can be argued that a component of risk perception is the impact associated with the action. Beyond the individual, risk perception is a cultural and societal construct influenced by symbols, ideologies, and values (Weinstein, 1980).

Natural and geological hazards significantly impact affected populations, and risk perception plays a crucial role in disaster risk (Cal et al. 2023). However, understanding people's perceptions of these hazards remains a challenging task, often overlooked. Limited surveys have been conducted regarding public perception of hazards. This research aims to assess people's risk perception based on gender in Multi-Hazard Areas of Pakistan. Understanding how individuals prepare for and perceive potential dangers is vital for effective disaster risk reduction strategies. Through improved awareness of risk and hazards, as well as a better understanding of how different genders perceive them, capacity to manage natural hazards can be enhanced (Sullivan-Wiley & Short Gianotti, 2017).

The study proposes a method to measure risk perception focusing on university students in Azad Kashmir, Pakistan. The objective is to gauge people's perceptions of risk, considering factors such as fear, attitude, awareness, and trust. The study's sample size was 392. Results indicated that female students exhibited greater concern than male students, with fear emerging as the highest scoring risk perception indicator among those tested. Significant differences between male and

female students in their perceptions of hazards were observed. The study underscores the importance of considering gender in assessing risk perception to inform disaster risk management policies.

Risk Perception

Risk involves ambiguity regarding the implications of an action concerning elements that humans value, such as well-being, health, wealth, property, and the environment, focusing on undesirable consequences (Tefera, 2024). Risk management is a policy aimed at countering and minimizing the effects of specific risks. It requires a better understanding of the type and intensity of effects a particular area may face or be vulnerable to. However, preparedness initiatives can only be successfully implemented if the people in the concerned area have a better perception beforehand and a sound strategy afterward to counter the actual risk (Rana & Routray, 2016). Generally, hazard and risk are often used interchangeably (Wachinger et al., 2010). A hazard can be defined as a situation or event that poses a threat to human life or has the potential to endanger the environment or property. Hazards have two main categories: man-made and natural hazards, both of which can be potential sources of harm (Babkin et al. 2023). Conditions, events, or environments can create hazards when their nature is disrupted by any means, causing damage. The probability of that harm being realized in a specific incident, combined with the magnitude of potential harm, constitutes its risk. Sullivan-Wiley and Short Gianotti (2017) conducted detailed research on Ugandan communities, as these areas are exposed to many artificial as well as natural hazards and risks.

Avvisati et al. (2019) investigated the three-dimensional variance of risk perception in Campania, Italy. Investigations were conducted on schoolchildren's and administrators' risk awareness and perception in the Tuscany region of Italy (Bandecchi et al., 2019). Cvetković et al. (2019) investigated the component of fear in risk perception concerning various dangers among young people from Macedonia, Serbia, and Turkey. Generally, fear is defined as the emotion humans experience when exposed to a threat or hazard. The public fears the potential outcomes of disasters (Slovic et al., 1980). Past records and ongoing public perceptions about

the risk can easily determine the prospect of the hazard. Also, risk perception and attitude can affect human behavior (Khan et al., 2020). Stress due to fear and worry can influence the perception of the possible occurrence of a disaster and can easily lead to detrimental results (Shreve et al., 2016). So, fear can also pave the way for taking precautionary and preventive measures to counter the expected hazard. Human behaviors in response to a specific hazard determine and affect exposure to that particular hazard (Rohrmann, 2008). Lack of awareness and poor risk perception often lead to poor responses (Armaş & Avram, 2009), hence often proving highly risky and fatal. Knowledge, awareness, and perception of hazards can paint a picture of possible outcomes and countermeasures against the predicted hazard (Sullivan-Wiley & Short Gianotti, 2017). People's behavior can be affected by the severity and their knowledge or perceptions about natural hazards. Perception and knowledge regarding controllability components or unlikelihood can contribute to a higher perspective on logical impact, which can cause panic (Ho et al., 2008; Anderson et al. 2024).

Manmade Hazards

Dangers resulting from human actions are known as man-made hazards. Examples include explosions, toxic waste leaks, pollution, dam collapses, conflicts, or civil unrest, which are often associated with businesses or energy production facilities (Kumar, 2024). The list of potential dangers is extensive. These hazards represent latent dangers constituted by the potential occurrence of dangerous phenomena, naturally capable of producing adverse effects on people, property, public services, and the environment. The technical integrity of buildings and structures to withstand the forces acting upon them during hazardous incidents is also crucial. Settlement expansion in hazardous areas without proper control exposes people to danger (Vallecha & To, 2024).

Natural Hazards

Earth's natural calamities include earthquakes, floods, and landslides. Whenever such natural hazards occur, there will be severe loss of life and property. Risks with meteorological, geological, or biological origins are brought about by natural processes. Cyclones, tsunamis, earthquakes, and volcanic eruptions are a few examples of natural risks because they have a purely natural cause (López-Saavedra & Martí, 2023). Socio-natural hazards include landslides, floods, droughts, and fires since they have both natural and human-caused causes. Even if structures are well-designed for seismic forces, the ground may collapse during an earthquake or landslide, causing the buildings on top to fall or slide and impact the towns below (Shareef, 2023).

Earthquake

A natural geological occurrence known as an earthquake is characterized by the abrupt release of energy in the Earth's crust, which causes seismic waves to travel through the Earth and shake the ground. The shifting of tectonic plates, faulting, or volcanic activity are the usual culprits for this energy release (Smith et al., 2020). Earthquakes are sudden, jarring shaking of the ground brought on by shifting tectonic plates under the Earth's surface. Seismic waves released during earthquakes cause surface rupture and ground shaking (Ray et al. 2024).

Landslides

The downward movement of a mass of rock, soil, or debris along an incline or slope is a geological phenomenon known as a landslide. Landslides and flooding are closely associated because both are related to intense rainfall, runoff, and ground saturation. The sudden movement of soil masses is one of the natural disasters known as landslides. Both natural conditions and human actions contribute to causing landslides (Sylvain et al. 2024). It is a natural phenomenon but is triggered by a number of geological, atmospheric, and human-made factors. Heavy rains, volcanic activity, earthquakes, and human activities like construction and

deforestation are just a few factors that might cause landslides (Gupta & Patel, 2019).

Floods

Floods are natural hazards distinguished by the overflowing or submergence of normally dry terrain. They can be caused by rainfall, storm surges, snowmelt, or dam failures, and they can cause extensive damage and population displacement. A flood is a type of natural hazard that occurs when water overflows into typically dry ground (Yang et al. 2023). Numerous factors, such as intense rainfall, dam failures, snowmelt, storm surges, or the rapid melting of ice, might produce floods. Two major factors usually combine to generate floods: physical processes causing changes in water masses and the geographic situation of the area where the flood occurs (Wijesinghe et al., 2023).

Hurricanes

Hurricanes are one of nature's most powerful storms. They produce strong winds, storm surge flooding, and heavy rainfall that can lead to inland flooding, tornadoes, and rip currents (Kyne, 2023). Hurricanes (Typhoons or Cyclones) are potent tropical storms with strong winds and significant rainfall. They are also referred to as cyclones in the Indian Ocean and typhoons in the western Pacific. Hurricanes can cause extensive destruction due to floods, storm surges, and wind-related damages (Gliksman et al. 2023).

Tsunamis

Large ocean waves known as tsunamis are caused by undersea seismic activities such as earthquakes, volcanic eruptions, or landslides (Reid & Mooney, 2023). Tsunamis, also known as seismic sea waves, produce enormous waves in a series due to underwater disturbances like earthquakes, landslides, and volcanic eruptions. A tsunami can travel with a speed of 100 miles per hour in the open ocean and generate waves up to a hundred feet or more (Baumgardner & Navarro, 2023).

Methodologies and Data

The growing multi-hazard environment affecting millions of people worldwide underscores the importance of ensuring that populations are increasingly better prepared through proper management. The nature of the research explains the perception of risk based on gender in Kashmir, as it is a multi-hazard environment. Calculating the perception of risk among the local public will not only aid in decision-making and conflict resolution but also in the reconstruction process. The study aims to determine the perception of risk among people based on gender in a multi-hazard environment. The units of analysis are the university students of Pakistan in a multi-hazard environment. The study focuses on calculating the perception of risk among people in areas affected by natural hazards such as earthquakes, landslides, and floods.

Results and discussion

Multistage cluster and simple random sampling techniques were used to collect data from a sample size of 392 through questionnaires on a five-point Likert scale. This was accomplished with the help of printed surveys distributed to university students in Kashmir, a region prone to numerous natural disasters. The survey included 164 male and 192 female participants. Chi-square tests were used to analyze whether there were any significant differences regarding attitude, fear, behavior, and trust in the context of landslides, earthquakes, and floods. Student t-tests were applied to all four components in relation to landslides, floods, and earthquakes.

Demographic Analysis

For earthquakes, the average fear factor among male students was 2.67, while among female students, it was 3.46. Similarly, the average behavior score for males was 2.91, and for females, it was 3.39. The awareness component had an average score of 2.98 for males and 3.40 for females. Trust values for males were 3.33, and for females, they were 3.69 (see, Figure 1).

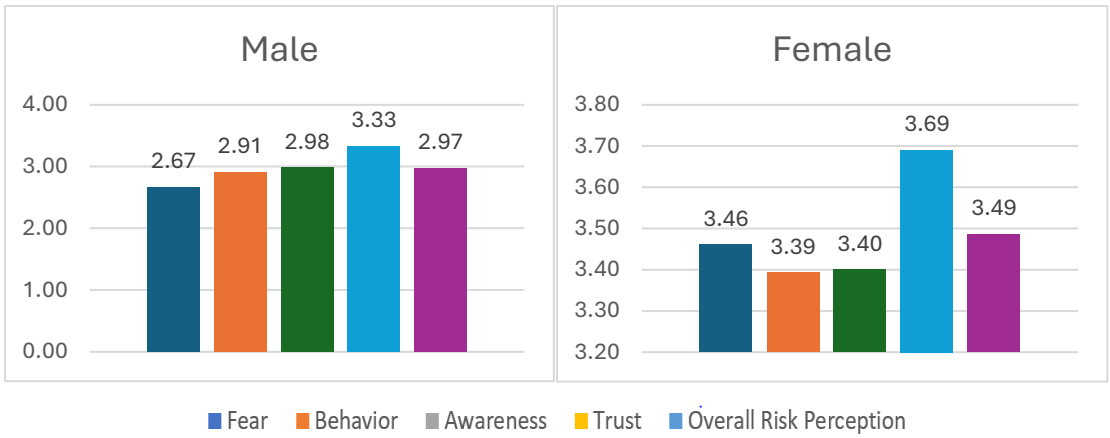

Figure 1: Demographic Analysis of Earthquake-Related Factors

Source: Author's survey.

The overall risk perception, calculated by summing all four components and then dividing by four, had a value of 2.97 for males and 3.49 for females. The results indicate that female university students were more concerned than male students. In Figure 2, regarding floods, the average fear factor among male students was 2.86, while among female students it was 3.41.

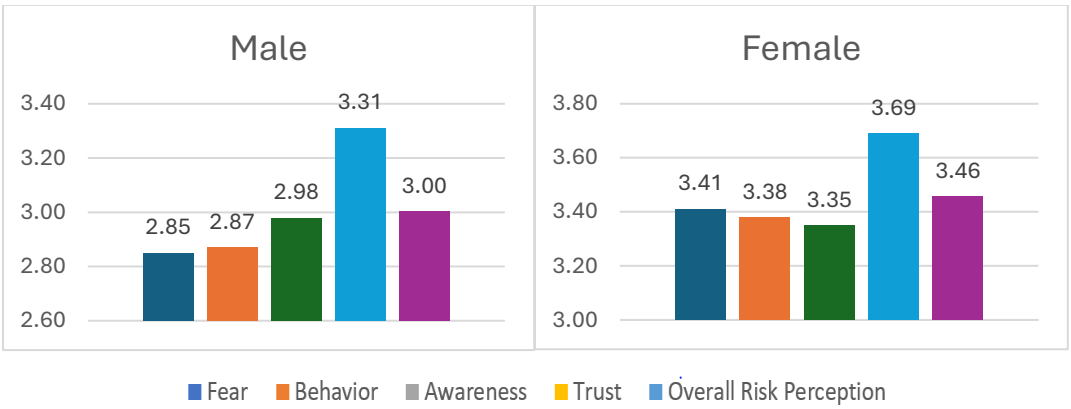

Figure 2: Demographic Analysis of Flood-Related Factors

Source: Author's survey.

Similarly, for behavior, the average value for males was 2.87 and for females it was 3.38. The awareness component for males showed a value of 2.98, and for females, it was 3.35. In terms of trust, males had a value of 3.31, whereas females had 3.69. The overall risk perception was 3.0 for men and 3.46 for women. In Figure

3, regarding landslides, there was a variation in the average values of all four components.

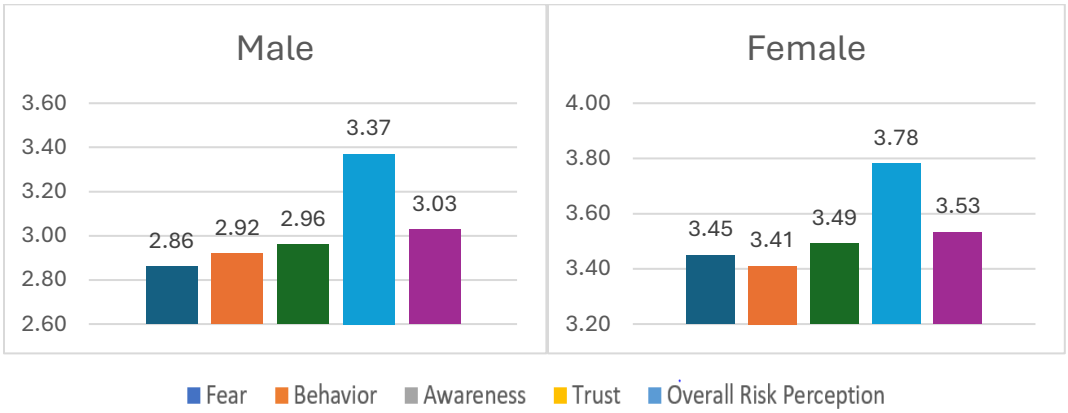

Figure 3: Demographic Analysis of Landslide-Related Factors

Source: Author's survey.

In terms of fear, men had an average of 2.86, while women had 3.45. For behavior, the average for females was 3.41 and for males it was 2.92. Similarly, for awareness, the average value for male students was 2.96 and for females it was 3.49. The trust component had a value of 3.37 for male students and 3.78 for female students. Overall risk perception for landslides also yielded different values for both genders, with it being 3.03 for males and 3.53 for females.

Risk Perception of Fear

In Table 1, measuring risk perception of fear is an important component that is further divided into a number of subcomponents, including the perceived extent of fear, fear of future occurrences, fear of disrupting the educational process, fear for the safety of others, and fear based on knowledge

Table 1: Subcomponents of Risk Perception Related to Fear

Fear	Earthquake			Flood			Landslide		
	M	F	Chi-square	M	F	Chi-square	M	F	Chi-square
F1	2.54	3.57	54.66[a]	2.6	3.13	17.2	2.68	3.56	38.8a
F2	2.79	3.41	23.06 [a]	2.65	3.46	36.7	2.7	3.55	35.35 [a]
F3	2.21	3.57	81.28 [a]	3.12	3.64	16.73[a]	3.08	3.44	19.48 [a]
F4	2.83	3.52	28.93 [a]	2.78	3.47	23.84[a]	2.87	3.27	9.88[b]
F5	2.76	3.37	22.28 [a]	2.96	3.45	15.91[a]	3.01	3.53	19.8 [a]

Source: Author's estimate. Note: [a]. p-value< 0.01, [b]. p-value< 0.05.

F1: Fear's Perceived Extent

In the case of earthquakes, the average fear level was 2.54 for males and 3.57 for females. When the chi-square test was performed to check for significant differences between genders, it was evident that male and female students differed significantly, as the p-value was less than 0.01 (χ^2 = 54.66, p-value = 0.000). For floods, the average fear level was 2.6 for boys and 3.13 for girls, with a significant difference between the two groups due to the smaller p-value (χ^2 = 17.2, p-value = 0.002). In the case of landslides, boys had an average fear level of 2.68, while girls had an average of 3.56. The chi-square test showed a significant difference between genders, with a p-value less than 0.01 (χ^2 = 38.8, p-value = 0.000). Hence, it was concluded that female students have a higher rate of fear compared to male students for all hazards.

F2: Fear of Future Occurrence

Fear of the future occurrence of natural hazards is also an important aspect of risk perception. For earthquakes, an average of 2.79 was observed for boys and 3.41 for girls. The chi-square test indicated a significant difference between genders,

as the p-value was less than 0.01 (χ^2 = 23.06, p-value = 0.000). For floods, the average was 2.65 for boys and 3.46 for girls, with a significant difference observed (χ^2 = 36.7, p-value = 0.000). For landslides, the average fear of future occurrence was 2.7 for boys and 3.55 for girls, with a significant difference between genders (χ^2 = 35.35, p-value = 0.000). It was clearly observed that women were more worried about the future occurrence of all hazards compared to boys.

F3: Disturbance of the Education Process

Natural hazards can also disrupt the education of students, so this component was also measured. For earthquakes, an average of 2.21 for boys and 3.57 for girls indicated concern about educational disruption, with a significant difference between genders (χ^2 = 81.28, p-value = 0.000). For floods, an average of 3.12 for boys and 3.64 for girls showed concern about educational disruption, with a significant difference observed (χ^2 = 16.73, p-value = 0.002). In the case of landslides, men showed an average of 3.08, while women showed an average of 3.44, with a significant difference between genders (χ^2 = 19.48, p-value = 0.000). It was clearly observed that female students are more worried about the disturbance of their education by natural hazards.

F4: Danger for Fellows and F5: Fear on the Basis of Knowledge

Similar results were found for F4: Danger for Fellows and F5: Fear on the Basis of Knowledge. Generally, female students feel greater concern compared to male students for all hazards based on their knowledge.

Risk Perception of Behavior

In Table 2, behavior is further divided into four components: ability to cope, adjustment in lifestyle, change in relationship with society, and change in relationship with peers.

Table 2: Subcomponents of Risk Perception Related to Behavior

Behavior	Earthquake			Flood			Landslide		
	Male	***Female***	***Chi-square***	***Male***	***Female***	***Chi-square***	***Male***	***Female***	***Chi-square***
B1	2.76	3.27	20.56[a]	2.8	3.36	22.81[a]	2.9	3.23	13.65[a]
B2	2.95	3.39	14.41[a]	2.92	3.35	21.37[a]	2.94	3.38	16.81[a]
B3	2.99	3.54	21.87[a]	2.88	3.42	23.68[a]	2.97	3.43	21.72[a]
B4	2.93	3.37	14.23[a]	2.87	3.4	9.92[b]	2.86	3.59	36.62[a]

Source: Author's estimate. Note: [a]. p-value< 0.01, [b]. p-value< 0.05.

The average perception of males was 2.76 and for females, it was 3.27 in dealing with earthquakes. Both groups were significantly different from each other (χ^2 = 20.56, p-value = 0.000). For floods, the average perception for women was 3.36 and for men, it was 2.8, again showing a significant difference (χ^2 = 22.81, p-value = 0.000). In the case of landslides, men showed an average of 2.9 while women showed an average of 3.23, and they were significantly different from each other (χ^2 = 13.65, p-value = 0.008). Similar results were obtained for B2, B3, and B4.

Risk Perception of Awareness

Awareness is divided into five components: familiarity with hazards, familiarity with the rescue process, awareness of university protection measures, awareness of the causes of hazards, and awareness of past experiences (see, Table 3). About 3.04 of male students and 3.48 of female students thought they were familiar with earthquakes, and both showed a significant difference (χ^2 = 21.27, p-value = 0.000). For floods, the average value for men was 2.95 and for women, it was 3.32; both were not significantly different from each other (χ^2 = 8.93, p-value = 0.063).

Table 3: Subcomponents of Risk Perception Related to Awareness

Awareness	Earthquake			Flood			Landslide		
	Male	*Female*	*Chi-square*	*Male*	*Female*	*Chi-square*	*Male*	*Female*	*Chi-square*
A1	3.04	3.48	21.27[a]	2.95	3.32	8.93[c]	2.9	3.5	15.54[a]
A2	3.02	3.42	31.74[a]	2.98	3.32	31.78[a]	2.95	3.33	7.73[c]
A3	2.83	3.36	18.2[a]	2.9	3.3	26.37[a]	3.03	3.54	19.13[a]
A4	2.94	3.31	7.58[c]	3.04	3.55	22.8[a]	2.88	3.53	20.03[a]
A5	3.05	3.44	9.92[b]	3.01	3.25	17.24[a]	3.02	3.55	14.31[a]

Source: Author's estimate. Note: [a]. p-value< 0.01, [b]. p-value< 0.05, c. p-value<0.090.

For landslides, women had an average of 3.5 and men had an average of 2.9, and both were significantly different from each other (χ^2 = 15.54, p-value = 0.004). Similarly, for A2: Familiarity with the Rescue Process, A3: Protection of the University, A4: Familiarity with Causes of Hazards, and A5: Past Experience.

Risk Perception of Trust

Trust has five subcomponents: trust in information, trust in management agencies, trust in policies, trust in information, and trust in the evacuation plan (see, Table 4). An average of 3.37 for male students and 3.56 for female students indicated they have trust in the information regarding earthquakes obtained from different sources. In this case, both were not significantly different from each other (χ^2 = 4.84, p-value = 0.303). For floods, boys showed an average of 3.27 and girls showed an average of 3.61, and both were significantly different from each other (χ^2 = 10.9, p-value = 0.028).

Table 4: Subcomponents of Risk Perception Related to Trusts

Trust	Earthquake			Flood			Flood	Flood	Flood
	Male	Female	Chi-square	Male	Female	Chi-square	Male	Female	Chi-square
T1	3.37	3.56	4.84	3.27	3.61	10.9[b]	3.31	3.75	23.34[a]
T2	3.34	3.72	10.5[b]	3.22	3.65	17.85[a]	3.35	3.76	12.19[b]
T3	3.3	3.69	15.67[a]	3.25	3.62	22.9[a]	3.47	3.77	7.68[c]
T4	3.27	3.63	11.95[b]	3.43	3.82	28.81[a]	3.34	3.73	15.55[a]
T5	3.35	3.85	14.23[a]	3.38	3.74	10.26[b]	3.4	3.88	13.71[a]

Source: Author's estimate. Note: [a]. p-value< 0.01, [b]. p-value< 0.05, c. p-value<0.090.

For landslides, an average of 3.31 for boys and 3.75 for girls was observed, and both were significantly different from each other ($\chi^2 = 23.34$, p-value = 0.000). Similar results were obtained for T2: Trust in Management Agencies, T3: Trust in Policies, T4: Trust in Information, and T5: Trust in Evacuation Plans. Table 5 shows the results of an independent sample t-test performed to check the differences in perception about hazards between male and female university students. The four components observed were fear, awareness, trust, and behavior.

Table 4: Independent Sample T-Test Results for Perception of Hazards between Male and Female University Students

Gender-Based Risk Perception	Earthquake		Flood		Landslide	
	t-stat	p-value	t-stat	p-value	t-stat	p-value
Fear	-6.919	0.000	-5.109	0.000	-7.145	0.000
Behavior	-6.436	0.001	-17.207	0.000	-6.285	0.002
Awareness	-8.339	0.000	-6.476	0.000	-10.481	0.000
Trust	-6.785	0.001	-6.637	0.000	-10.501	0.000

Source: Author's estimate.

The results show that in all cases, there was a significant difference among university students based on gender regarding fear, behavior, awareness, and trust about floods, earthquakes, and landslides. Female students seem to have more apprehension of risk perception compared to male students.

Conclusion

The main purpose of this research was to determine the variation in risk perception based on gender among university students regarding floods, earthquakes, and landslides. Understanding the perception of students regarding risk is a crucial component in preparing future plans to handle disaster risks and making the world safer from such dangers. Risk perception research, especially in universities, is critical as it provides insight into the perception of those who are directly impacted by environmental factors. This study reveals a method to identify and measure the perception of people based on gender in multi-hazard areas of Pakistan, which can inform disaster risk management policies and emergency preparedness activities. The gender component should not be overlooked in risk

perception studies aimed at reducing vulnerability in multi-hazard areas and promoting economic development. The study results can be valuable for disaster managers, policymakers, and school administrations in designing emergency plans and preparedness strategies to mitigate disaster risks. The study suggests that raising awareness about potential disasters is essential, and understanding the perception of young people is crucial for promoting personal responsibility for protection and disaster preparedness. Underestimating the intensity of threats may lead people to neglect necessary precautions to protect themselves.

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