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RELATIONSHIP BETWEEN COMMUNITY RESILIENCE, DISASTER PREPAREDNESS, AND PUBLIC HEALTH EMERGENCY READINESS

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Abstract

Background: *Public health emergency management incorporates community resilience and disaster preparedness. Enhanced community resilience and disaster response and recovery strengthen community capacities to deal with adverse events and public health emergency situations. There is limited evidence concerning community resilience, disaster preparedness, and public health emergency management among the community members in Swat, Pakistan.*

Aim*: To assess the relationship between community resilience, disaster preparedness, and public health emergency readiness among community members in Swat, Khyber Pakhtunkhwa, Pakistan.*

Methods: *This was a cross-sectional quantitative correlational study. 377 community members were selected by probabilistic sampling. Community members were assessed by a structured questionnaire that contained socio-demographic data, community resilience, and disaster preparedness and public health emergency readiness. Data were analyzed in SPSS version 26. Descriptive statistics, Pearson correlation, and multiple regression were computed. A p-value less than 0.05 was deemed statistically significant.*

Results: *The study participants had an average level of community resilience (3.72 ± 0.59), disaster preparedness (3.54 ± 0.63), and public health emergency readiness (3.61 ± 0.56). There was a positive correlation among community resilience, disaster preparedness, and public health emergency readiness, with the strongest correlation being among disaster preparedness and public health emergency readiness. Community resilience (β = 0.356) and disaster preparedness (β = 0.487) were significant predictors of public health emergency readiness ($p < 0.001$).*

Conclusion: *The findings of the study revealed that community resilience and disaster preparedness improve public health emergency readiness. Community disaster readiness and resilience building can lead to an improved capacity of response to disasters in vulnerable communities.*

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Introduction

Disasters and crises in public health have become more common and more serious in ways that threaten the capacity of healthcare systems and the communities that they serve. The compounding effects of climate change, urbanization, environmental degradation, and population growth and the emergence of newly infectious diseases have increased the impact and frequency of disasters. They threaten the health of the population, the viability of economies, the integrity of society, and sustainable development. Communities are more often called upon to endure and/or respond to multiple simultaneous disasters. This strengthens the case for building resilience and preparedness in the community (Ma et al., 2023; Khatri et al., 2023). For these reasons, public health on a global scale today embraces the preparation for and mitigation of the effects of disasters as essential elements of its core activities and community resilience is a vital component of the improvement of the preparedness and capacity for response to emergencies.

Disasters and crises have not diminished in spite of the considerable investments that have been made in the systems designed to manage them. Health care and community functioning are disrupted by climate-related disasters, including floods, droughts, hurricanes, heat waves, and wildfires. The COVID-19 pandemic and other public health emergencies have underscored the need for strong collaboration between health systems and communities if preparedness for these emergencies is to be comprehensive. It is suggested that more resilient and socially cohesive communities recover more quickly from emergencies, have better mental health during and after the emergency, and are more effective at responding to the emergency (Hall et al., 2023; Wang et al., 2021). These studies show how essential community resilience is in emergency planning and in public health planning.

Community resilience, disaster readiness, and public health emergency preparedness present an integrated system for understanding a community's ability to deal with adverse situations. Community resilience is defined as the ability of individuals, families, organizations, and communities to respond to and recover from adverse situations and maintain core activities (Ma et al., 2023). Disaster preparedness is the planning, instruction, practice, and organization of resources and activities in advance of a disaster to lessen the impact of the disaster (Sharma & Sharma, 2020). Public health emergency preparedness is the capability of the health system to recognize, respond to, and recover from a health crisis in a coordinated manner with effective governance and communication (Khatri et al., 2023). The interrelatedness of the concepts improves the management of disasters and public health.

Different theoretical frameworks support the understanding of the relationship of community resilience, disaster readiness, and emergency preparedness. The contemporary resilience framework states that resilience is determined by social networks, governance, institution, and communication systems. Community engagement, local leadership, and shared responsibility are critical in building pre-disaster resilience (Wang et al., 2021). Recently indigenous knowledge has been recognized as having a positive impact on the local response to disasters preparedness, particularly in vulnerable populations. (Zavaleta-Cortijo et al., 2023). The above concepts validate the importance of a multidimensional framework in disaster preparedness that combines institutional preparedness with community mobilization.

Disaster research has recently emphasized community resilience, yet numerous conceptual and methodological discussions remain open. Some researchers argue that resilience should be conceptualized as an outcome of a disaster or as a continuous adaptive process of developing and strengthening resilience. The variation in the method of measurement of resilience also leads to significant gaps in the ability to compare different communities, regions, and countries. Some researchers have called for more integrated frameworks for the assessment of resilience that incorporate social, institutional, and economic and health dimensions (Fenxia, 2022). Other researchers have argued that in addition to addressing infrastructure gaps to develop disaster

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preparedness, the lessons learned from recent public health emergencies have demonstrated that social cohesion, community engagement, and public confidence are critical factors (Hall et al., 2023). These studies underscore the requirement for the development of integrated and comprehensive disaster preparedness frameworks that address both physical and social resilience.

Due to high population density and rapid urbanization, coupled with environmental degradation and increased climate-related hazards, South Asia remains one of the most disaster-prone regions. Located in this area, Pakistan is particularly vulnerable to floods, earthquakes, landslides, droughts, heatwaves, and the outbreaks of diseases that severely undermine the development of the health-care system and the economy. Within Pakistan, several studies have reported large gaps in the management of disaster risk, emergency preparedness, and the institutional preparedness of schools and communities (Shah et al., 2020). The health-care system also suffers from large gaps in planning for emergencies, as well as a lack of resilient infrastructure and staff, and an absence of coordinated responses to emergency situations (Sharma & Sharma, 2020). The results of these studies reveal the ongoing imperative to strengthen emergency preparedness and resilience across multiple sectors in Pakistan.

Socioeconomic deprivation combined with scant resources for health care, transportation, and communication and poor infrastructure leaves many communities in Pakistan, especially at the rural and underserved levels, highly vulnerable. Finally, the lack of planned emergency communications and insufficient disaster preparedness initiatives exacerbate these communities' vulnerability. Rural and underserved communities are often excluded from the emergency planning and disaster preparedness activities. Thus, they become even more vulnerable in a crisis. Community resilience, disaster preparedness, and emergency response have been studied independently, and there has been a dearth of research on the interdependence of these constructs in Pakistan. There is little to no literature on how community resilience enhances disaster preparedness and public health emergency readiness. This gap in knowledge will provide important evidence for community planners, healthcare practitioners, and disaster responders to create evidence-based practices aimed at improving resilient communities and public health emergency preparedness in Pakistan (Ma et al., 2023; Shah et al., 2020; Khatri et al., 2023).

Methods

This study examined the relationship between community resilience, disaster preparedness, and public health emergency readiness in the context of Khyber Pakhtunkhwa, Pakistan, using a quantitative, cross-sectional, correlational research design. The study was located in selected communities of Swat. Based on a 95% confidence level, 5% margin of error, and 50% response distribution, the Raosoft Sample Size Calculator determined a target population of 377 participants. An appropriate technique of probability sampling was used to select participants. The adult participants (≥18 years) were confined to the legally participating population of Swat, and self-selected to participate. The study was ethically approved by an Institutional Research Board (IRB). Informed, signed, consents were secured from all participants. During the study sealed the respondents' rights to be informed to the study process, to participate voluntarily, to remain anonymous, and to leave the study at any time.

Data Collection Procedure

Data were collected with a structured, self-administered questionnaire with four sections: socio-demographic characteristics; community resilience; disaster preparedness; and public health emergency preparedness. The questionnaire was a modified version of some validated questionnaires and was reviewed by some subject experts for content validity. A pilot study, prior to the main survey, was done to assess the clarity, reliability, and feasibility of the questionnaire. After obtaining the relevant authorities' and community leaders' approvals from Swat, trained data collectors approached participants, explained the study, and, with the participants' written informed

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consent, distributed the questionnaires. Participants completed the questionnaires with the assistance of the data collectors, if needed, and the data collectors ensured the returned questionnaires were complete. The questionnaires were coded and entered into a database for statistical analysis.

Data Analysis Procedure

Data were analyzed using SPSS: Version 26. Data were screened for entry inaccuracies and were subjected to descriptive statistics, which included frequencies, percentages, means, and standard deviations. The internal consistency of the measurement scales was obtained using Cronbach's alpha coefficient. Community resilience, disaster preparedness, and public health emergency readiness were all assessed for inter-correlations using Pearson's correlation. Further, the socio-demographic variables were regressed to assess the effects of community resilience and disaster preparedness on public health emergency readiness, and multiple linear regression was employed for the analysis. Statistical significance was set at a p-value of 0.05.

Results

Table 1 shows the socio-demographic data of the 377 participants. The most frequent age group (32.9%) was 18–29 years, followed by 30–39 years (28.6%). The participants aged 50 years and above were the least represented (16.7%). The majority of the participants were males (80.1%). Most of the participants were married (62.3%); 33.4% were single; and 4.2% were widowed or divorced. About a quarter of the participants (28.9%) had attained secondary education, while 21.8% had completed higher secondary education. Those with a graduate degree and above accounted for 18.3%. Further, 18.0% of the participants had primary education, and 13.0% had no formal education. Participants engaged in different occupations, with the highest proportion (25.5%) being private employees, followed by housewives (19.6%), government employees (18.8%), business persons (14.1%), farmers (12.7%), and others (9.3%). More than half the participants (57.0%) resided in rural areas, while the remaining 43.0% lived in urban areas.

Table 1. Socio-Demographic Characteristics of Participants (N = 377)

Variable	Category	Frequency (n)	Percentage (%)
Age (years)	18–29	124	32.9
	30–39	108	28.6
	40–49	82	21.8
	≥50	63	16.7
Gender	Male	302	80.1
	Female	75	19.9
Marital Status	Single	126	33.4
	Married	235	62.3
	Widowed/Divorced	16	4.2
Education	No formal education	49	13.0
	Primary	68	18.0
	Secondary	109	28.9
	Higher Secondary	82	21.8
	Graduate and above	69	18.3
Occupation	Government employee	71	18.8
	Private employee	96	25.5
	Business	53	14.1
	Farmer	48	12.7
	Housewife	74	19.6

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	Other	35	9.3
Residence	Urban	162	43.0
	Rural	215	57.0

Table 2 presents the descriptive statistics for the three primary variables of the study. The respondents' average score for assessing community resilience was 3.72 (SD = 0.59), indicating that community members displayed a relatively high degree of resilience. The respondents' average score for assessing disaster preparedness was 3.54 (SD = 0.63), indicating a moderate degree of preparedness to deal with disaster occurrence. The average score for assessing public health emergency preparedness was 3.61 (SD = 0.56), which indicated a moderate to high degree of public health emergency preparedness among the respondents. The relatively small standard deviations reflected an even smaller degree of variation among respondents, indicating homogeneity of perceptions among the study participants.

Table 2. Descriptive Statistics of Community Resilience, Disaster Preparedness, and Public Health Emergency Readiness

Variable	Mean	Standard Deviation	Minimum	Maximum
Community Resilience	3.72	0.59	2.05	4.95
Disaster Preparedness	3.54	0.63	1.95	4.90
Public Health Emergency Readiness	3.61	0.56	2.10	4.88

The 3rd Table includes the Pearson correlation coefficients of community resilience, preparedness for disasters, and readiness for public health emergencies. Community resilience had a large positive correlation with the preparedness for disasters (r = 0.612), showing that resilient individuals tended to report greater preparedness for disasters. Community resilience also showed a large positive correlation with the readiness for public health emergencies (r = 0.681). Correlation of preparedness for disasters and readiness for public health emergencies was strongest (r = 0.724). It can be concluded that greater community resilience and preparedness for disasters facilitate greater readiness to respond to public health emergencies.

Table 3. Pearson Correlation between Community Resilience, Disaster Preparedness, and Public Health Emergency Readiness (N = 377)

Variables	1	2	3
1. Community Resilience	1		
2. Disaster Preparedness	0.612	1	
3. Public Health Emergency Readiness	0.681	0.724	1

Table 4 shows the results of the multiple linear regression analyzing the predictors of readiness to public health emergencies. Community resilience (β = 0.356, $p < 0.001$) and preparedness for disasters (β = 0.487, $p < 0.001$) were both significant positive predictors with the greatest predictive power being for preparedness for disasters. Higher education level also was a positive significant predictor of emergency readiness (β = 0.149, p = 0.001). Age (p = 0.115) and gender (p = 0.244) were not significant predictors. The regression model had an R^2 of 0.622, and the overall model showed a significant effect, and therefore, great explanatory power (F = 101.84, $p < 0.001$).

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Table 4. Multiple Linear Regression Analysis Predicting Public Health Emergency Readiness

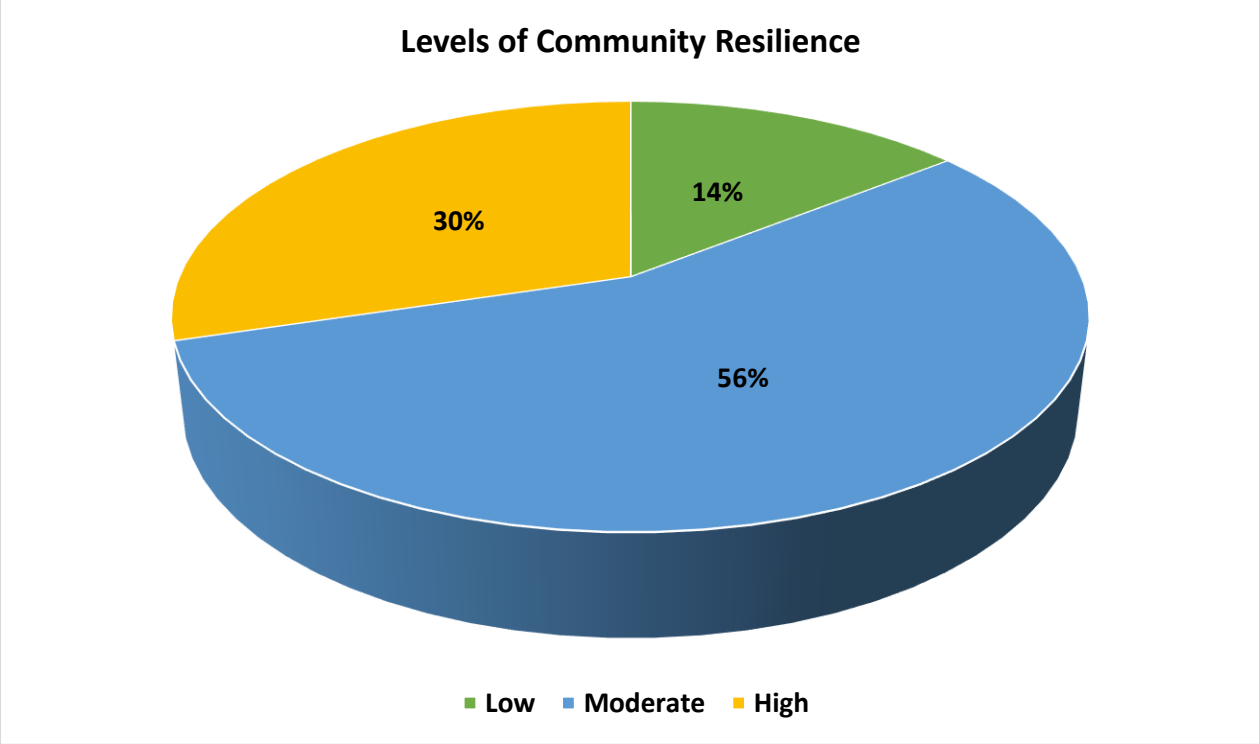
Predictor Variable	B	SE	β	t	p-value
Constant	0.842	0.214	–	3.94	<0.001
Community Resilience	0.328	0.046	0.356	7.13	<0.001
Disaster Preparedness	0.471	0.049	0.487	9.61	<0.001
Age	0.019	0.012	0.061	1.58	0.115
Gender	0.044	0.038	0.046	1.17	0.244
Education Level	0.097	0.028	0.149	3.46	0.001

Model Summary

Statistic	Value
R	0.789
R^2	0.622
Adjusted R^2	0.616
F	101.84
p-value	<0.001

Figure1 depicts participants' levels of community resilience. A moderate level of community resilience was seen in 56.0% of respondents, while 29.7% of respondents showed a high level of resilience. A low level of community resilience was identified in only 14.3% of participants. It can be seen that there is a high level of community resilience among community members, indicating the community has the capacity to cope with and recover from the problems that are posed by the challenges of a disaster.

Figure 1. Levels of Community Resilience among Participants



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Figure 2 shows the levels of disaster preparedness of participants. The majority of respondents (52.5%) showed a moderate level of disaster preparedness. A high level of disaster preparedness was seen in 29.7% of respondents, while low disaster preparedness was seen in 17.8% of respondents. From the results, it can be seen that a significant portion of participants has a moderate level of disaster preparedness, and a large number of participants requires further education, training, and preparedness programs to increase disaster preparedness.

Figure 2. Levels of Disaster Preparedness among Participants

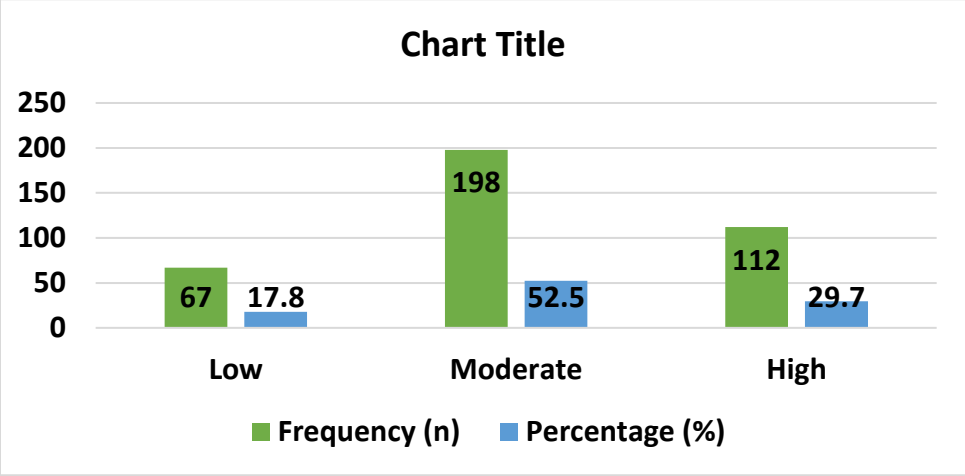
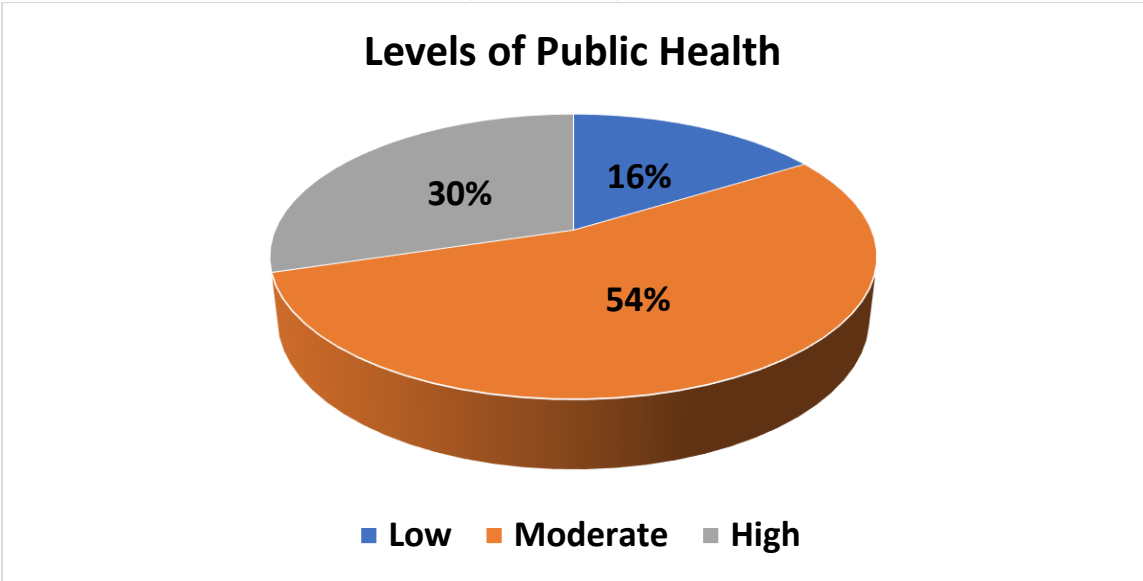


Table 3 captures the data regarding the participants' public health emergency readiness. The majority of participants (54.1%) reflected a moderate level of emergency readiness. However, a considerate population of participants (29.7%) was found to be ready to a high degree. The rest of the participants (16.2%) reflected a low level of emergency readiness. The response indicates that the majority of the participants are prepared to a moderate extent to meet the demands of a public health emergency. Those who are unprepared need special measures to increase their emergency preparedness level.

Figure 3. Levels of Public Health Emergency Readiness



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Discussion

The current research explores community resilience, disaster preparedness, and public health emergency readiness in Swat, Khyber Pakhtunkhwa, Pakistan. Reported levels of community resilience, disaster preparedness, and public health emergency readiness were measured as moderate. Participants having the ability to respond to emergencies indicates that there is still enough room to fortify preparedness and resilience by implementing formal interventions. Other studies have shown that preparedness and resilience in communities is moderate due to having experienced disasters and developed local coping and engagement methods, but limited preparedness is due to lack of resources and institutions (Fenxia, 2022; Abrash Walton et al., 2021). Research done in communities that are prone to experiencing disasters have shown that preparedness is a lack of comprehensive nature, and that there is inadequate investment in building resilience, even if the community has preparedness awareness (Guo et al., 2020).

The present study surveyed community resilience and disaster preparedness and identified a positive correlation between the two variables. Resilience in the form of social networks, community trust, and greater access to community resources all correlate with higher levels of disaster preparedness. These findings are in agreement with the literature which suggest that preparedness participation, emergency response planning, and disaster risk management are all the greater in resilient communities (Sim et al., 2021; Sadeka et al., 2020). Studies conducted in Hong Kong and rural China identified that community and disaster preparedness is greatest when there is social cohesion, information sharing, and responsive participation (Guo et al., 2020; Sim et al., 2021). Some studies in low resource settings reported a weaker correlation due to the gap in preparedness being linked to socioeconomic disparity and the lack of preparedness being linked to a deficit in activity and support from agencies (Tanabe et al., 2022).

The findings indicated a strong positive relationship between community resilience and the readiness to respond to public health emergencies. Respondents who had high resilience demonstrated high readiness to respond to public health emergencies. This finding is consistent with previous studies that suggested resilient communities respond to health emergencies better due to strong governance systems, and resilient communication and collaboration systems (Wang et al., 2021; Ellis et al., 2022). The public health emergency response systems have also shown that resilience improves health security by strengthening community response and emergency communication and coordinated response (Khatri et al., 2023). The studies conducted after the COVID-19 pandemic suggested that resilient communities in the control of the pandemic and public health interventions were those communities that had strong community involvement and local support systems (Fenxia, 2022).

The strongest association in this study was between disaster preparedness and the readiness to respond to public health emergencies. Respondents who indicated that they were prepared for disasters to a greater extent indicated that they had greater readiness for public health emergencies. These findings are in agreement with other studies that indicated that emergency planning and training, drills, and clear communication of risk enhance the preparedness to respond to an emergency (Khorram-Manesh & Burkle, 2020; Sharma & Sharma, 2020). Evidence has also shown that health security is enhanced by preparedness and the establishment of systems that improve coordination and response in health care (Khatri et al., 2023). Some studies have, however, shown low readiness despite a high degree of awareness in the community due to a lack of interest and funding to implement the preparedness initiatives across communities.

According to the analysis of multiple linear regression, community resilience and disaster preparedness predicted public health emergency readiness while gender and age did not have predictive power. Emergency readiness was positively predicted by education level, with higher levels of education associated with increased risk and health literacy and adoption of health protective behaviors. Knowledge, preparedness,

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and resilience of individuals play a larger role in emergency readiness in comparison to demographic factors. This has been found in earlier research (Ellis et al., 2022; Khatri et al., 2023). Research on health care and emergency response systems also finds preparedness competencies of individuals are influenced by higher education, advanced training, and disaster drills. Personal attributes have little to influence emergency preparedness. Some studies have found a relationship between demographic variables and preparedness. These studies suggest that cultural, geographic, and socioeconomic diversity among various populations may influence emergency preparedness.

According to the findings, over 50% of participants were found to have moderate community resilience, disaster preparedness, and public health emergency readiness, while around 30% demonstrated high levels. This indicated that Swat had a relatively good ability to respond to disaster situations; however, there is still a need for greater improvement in preparedness. Several previously conducted studies in Pakistan also stated that community members tend to have moderate preparedness. This is due to frequent flooding and earthquakes. Community members are often exposed to a wide array of emergency situations, which provides them with a level of practical experience. However, many disaster preparedness programs do not exist and therefore, they are not prepared in a formal sense (Tanabe et al., 2022; Shah et al., 2021). Research conducted in South Asia has also stated that preparedness is limited due to a lack of community trainings, emergency supplies, and insufficient execution of disaster reduction policies (Raheem et al., 2023).

This study builds on the collected evidence regarding disaster preparedness at the community level and the strengthening of community resilience as strategies for the public's preparedness for health emergencies. The supportive relationships discovered among the studied variables are consistent with existing theories regarding resilience, preparedness, and community as the primary elements for the effective management of the reduction of disaster risk and emergencies (Ellis et al., 2022; Wang et al., 2021). These findings demand the attention of planners and managers of public health, community, and emergency services in Pakistan. Community preparedness and resilience strengthening initiatives should include community education and training, health simulations, public health education, and the building of social capital and inter-sectoral partnerships. In addition, strengthening community resilience and preparedness for emergencies in Pakistan would benefit from additional, diverse, multi-centered studies using a longitudinal approach.

Conclusion

The present study concluded that participants in Swat reported community resilience, disaster preparedness, and public health emergency readiness at moderate levels. Positive relationships among the variables were documented. Higher community resilience and disaster preparedness contributed to public health emergency readiness. Among the predictors of emergency readiness, community resilience and disaster preparedness were important. Education was also relevant. The findings inform community-based programs for disaster and emergency preparedness and resilience to public health and other emergencies.

Recommendations

Based on the findings of the study, the following recommendations are proposed:

Community-based disaster preparedness and resilience-building programs should be implemented regularly to improve public health emergency readiness among community members.

Public health authorities should organize periodic disaster drills, simulation exercises, and awareness campaigns to strengthen emergency response knowledge and practical skills.

Educational interventions focusing on disaster risk reduction and emergency preparedness should be integrated into community health promotion programs, particularly in rural and disaster-prone areas.

Government agencies, disaster management authorities, healthcare organizations, and community leaders should strengthen

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collaboration to develop and implement comprehensive emergency preparedness strategies. Resources for emergency preparedness, including early warning systems, emergency supplies, and communication networks, should be enhanced to improve community response capacity during disasters.

Special attention should be given to vulnerable and low-preparedness populations through targeted training and community engagement initiatives to reduce disparities in emergency readiness.

Future research should employ longitudinal or interventional study designs in different regions of Pakistan to evaluate the effectiveness of resilience-building and disaster preparedness programs and to improve the generalizability of the findings.

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