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Scorching Minds: Quantifying the Impact of Heatwaves on Mental Health of Young Adults in Rural Lahore

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Abstract

Climate change–driven heatwaves are an increasing public health concern, yet their mental health impacts remain underexplored in rural populations of low- and middle-income countries. This quantitative cross-sectional study examined the association between heatwave exposure and mental health outcomes among young adults aged 18–35 years living in rural areas of Lahore, Pakistan. A total of 334 participants were selected using simple random sampling. Data were collected using standardized and validated instruments, including the Patient Health Questionnaire-9 (PHQ-9) for depression, Generalized Anxiety Disorder-7 (GAD-7) for anxiety, the Perceived Stress Scale, and the Pittsburgh Sleep Quality Index (PSQI). Heatwave exposure was operationally defined as repeated exposure to temperatures exceeding 40°C, along with assessment of access to cooling resources. Descriptive statistics indicated mild-to-moderate depressive symptoms, moderate anxiety levels, high perceived stress, and poor sleep quality among participants. Pearson correlation analysis revealed significant positive associations between heatwave duration and depression, anxiety, stress, and sleep disturbance ($p < .001$). Multiple linear regression analyses identified heatwave duration as a significant predictor of psychological distress, while coping capacity, employment status, and access to cooling facilities emerged as protective factors. Female participants reported significantly higher levels of stress and anxiety. The findings demonstrate that prolonged heatwave exposure is strongly associated with adverse mental health outcomes among rural young adults. These results highlight the need to integrate mental health screening and psychosocial considerations into heatwave preparedness and climate adaptation strategies, particularly in socioeconomically vulnerable rural communities.

Introduction

Climate change has been deemed as one of the most significant public health issues of the twenty-first century and extreme heat events have become a direct and increasing threat to the well-being of humans. Heatwaves, which can be described as a very prolonged period of high temperatures in comparison to the regional climatic conditions, have become more frequent, stronger, and longer-lasting around the world (IPCC, 2022; WHO, 2021). Although the physical health consequences of heat exposure such as dehydration, heatstroke, cardiovascular strain and respiratory complications have been well established, there is an increasing body of empirical evidence to suggest that heatwaves have profound psychological impacts. These consequences are increased anxiety, depressive, irritable, sleep disorders, aggression, and suicidal thoughts (Berry, Bowen, and Kjellstrom, 2010; Obradovich et al., 2018; Williams et al., 2013). Nevertheless, even with this growing body of evidence, the mental health aspect of heat exposure due to climate change has been

underrepresented in the policy of health of the population, especially in low- and middle-income nations.

On the physiological level, exposure to intense heat interferes with thermoregulation, triggers stress-response mechanisms, which impact neurochemical processes. High atmospheric temperatures correlate with a rise of cortisol and dysfunction of systems of serotonin and dopamine, which affect mood and intellectual processing (Kjellstrom et al., 2016). Sleep disturbance is one of the major processes that connect environmental heat to psychological suffering. The extensive studies indicate that warmer night temperatures lead to poorer sleep quality and amount, which then causes irritability, decreased emotional control, and worsened depressive symptoms (Obradovich et al., 2018). Besides biological mechanisms, the psychosocial also intensifies vulnerability. The heatwaves limit mobility, disorient day-to-day activities, diminish outdoor socialization, and add tension among individuals in the homes. Sustained exposure can also cause anticipatory anxiety of future climate instability, which is often referred to as eco-anxiety (Clayton and Karazsia, 2020).

Studies around the world record consistent links between excessive heat and negative psychological conditions. The meta-analyses and population-based studies indicate higher rates of anxiety and depression when there is a heat event (Schwartz et al., 2023; Obradovich et al., 2018). High-level aggression and interpersonal violence have also been noticed during high-temperature periods, which implies that environmental stressors contribute to behavioral control (Anderson et al., 2020). Australian, American, and Japanese studies suggest that there is an increment in the suicide rates during extended periods of heatwaves, which may be mediated by serotonergic dysregulation and a lack of impulse control (Page et al., 2012; Williams et al., 2013). All these data points to the fact that heatwaves are psychosocial stressors that have both short-term and long-term effects on mental health (Berry et al., 2010).

The psychological distress caused by heat does not evenly spread. Vulatile groups such as older adults, people with underlying mental health problems, outdoor workers and socioeconomically disadvantaged groups are disproportionately affected (Hansen et al., 2008; Williams et al., 2013). Young adults are one of the demographics that have not been considered in climate-mental health studies. Despite being more physically resilient than older populations, people between the age of 18 and 35 are often more susceptible to changes in life occurring in transitional periods, with an employment history of instability, educational demands and financial accountability, and shifting social roles. Such stressors can increase vulnerability to environmental disadvantage (Hayes et al., 2018). Also, coping mechanisms and emotion management abilities are yet to be solidified in early adulthood, which may increase susceptibility in times of environmental crises.

South Asia is one of the most climate-prone parts of the world. Excessive population, urbanization, reliance on agriculture, and inadequate adaptive infrastructure worsen exposure to extreme heat (Eckstein, Künzel, and Schafer, 2021). The Intergovernmental Panel on Climate Change estimates the escalation of thermal extremes in the area, such as potentially fatal wet-bulb temperatures, which degrade human thermoregulation (IPCC, 2022; Im et al., 2017). The empirical studies conducted in India confirm that higher wet-bulb temperatures are strongly linked to the depressive symptoms, especially those associated with rural and low-income groups (Rao et al., 2024). In Bangladesh, long-term heat exposure has been associated with mental disruptions and increased stress levels in the students (Rahman et al., 2023). The lack of mental health facilities in the region limits the access to formal psychological support, and the community members resort to the informal one that provides only partial alleviation.

The country is also one of the most vulnerable to climate change (UNDP, 2022). The provinces, including Sindh and Punjab, are prone to heatwaves of over 45C, with some even reaching the physiological survivability limit (Pakistan Meteorological Department,

2024; Raymond et al., 2020). Although all these environmental realities exist, the response to policy has been mostly focused on physical health effects and disaster preparedness, with little consideration given to mental health effects. Local studies show that a high prevalence of anxiety, depression, and irritability in heatwaves exists in urban and rural areas (Sarfraz et al., 2021). In a study in Malakand Division, 72% of rural women were found to be highly stressed, 68% had anxiety, and 56% displayed depressive symptoms during extreme heat events, and the social support was found to be protective (Niaz, 2024). These results highlight the influence of contextual aspects, such as gender norms, economic precarity, and infrastructural constraints, in determining psychological adaptations to climate stress.

Pakistan has unique structural weaknesses in rural communities. Homes are not ventilated well, and power outages restrict the adoption of cooling devices; most people also use their livelihoods as a source of outdoor work, and direct heat contact is more common (Nasir and Tariq, 2021). The gender norms can also limit the movement, especially of women by restricting their access to communal cooling and health facilities. The stigma related to mental health is still widespread, which results in underreporting of symptomatology and decreased help seeking (Javed & Khan, 2021). These overlapping environmental, socioeconomic, and cultural circumstances present a climate-related psychological distress high-risk environment.

Pakistan has a gap in research even though global and regional evidence has been accrued. The literature is mostly based on urban populations, the need to consider physical health outcomes, or quantitative techniques exclusively. There are very limited studies that combine standardized prevalence with qualitative research of lived experiences, coping abilities, and sociocultural factors. Mixed-methods studies are critical towards both quantifying the measurable syndrome patterns and the dynamic interactions that define the psychological resilience or vulnerability.

This gap is addressed in the current study since it explores the association between heatwave exposure and mental health outcomes among young adults aged 1835 years in rural Lahore, Pakistan. The research will aim to measure anxiety, depression, sleep disturbance and coping capacity levels using validated instruments like the Generalized Anxiety Disorder-7 (GAD-7) and the Patient Health Questionnaire-9 (PHQ-9) and place the findings in the context of lived experience. When combined with the quantitative and qualitative data, this study will add to the body of research on climate and mental health in the Global South and evidence to support culturally-competent, community-based adaptation responses. The state of heatwaves as an environmental and psychological threat needs to be acknowledged to come up with holistic policies to address climate resiliency, and protect the mental health of the vulnerable rural communities.

Literature Review

Global Evidence on Heatwaves and Mental Health

One of the most common and dangerous effects of climate change is heatwaves, the severity of which is growing more and more, and the duration is also recorded on the continents (IPCC, 2022; WHO, 2021). Although in the early studies emphasis was made on physical morbidity and mortality rate, in the recent past, scholarly work has been extended to include the psychological effects. The exposure to heat has been linked to anxiety, depressive symptoms, aggression, irritability, sleep disturbance, and suicide (Berry, Bowen, & Kjellstrom, 2010; Obradovich et al., 2018; Williams et al., 2013). The heatwave as a psychosocial stressor conceptualization does not only conceptualize extreme heat as an environmental phenomenon, but as a risk factor of emotional control and behavioral stability. It has been shown by met-analytic evidence that there are positive and stable relationships between high ambient temperatures and mental health services use, psychiatric hospital admissions, and mood instability (Schwartz et al., 2023). Australian,

United States, and Japanese population-level studies report higher suicide mortality when temperatures were high, indicating that neurobiological and behavioral mechanisms of action tied to temperature extremes causing impulsivity and emotional instability existed (Page et al., 2012; Williams et al., 2013). Anderson et al. (2020) also add that aggressive behavior and interpersonal violence increase statistically during heat events, which confirms the behavioral aspect of climate-related stress.

Psychological and Physiological Pathways

A number of mechanisms identify how heat waves are linked with mental health outcomes. Physiologically, high temperatures interfere with the thermoregulation mechanism and trigger stress-response systems, such as high cortisol secretions and the changes in serotonergic and dopaminergic activity (Kjellstrom et al., 2016). The neurochemical disequilibrium may affect cognitive processes, decision making and control of emotions. An example of an important mediator factor is sleep disruption. The article by Obradovich et al. (2018) makes use of large-scale satellite and survey data to show that increasing temperatures during the night have a significant negative impact on the duration and quality of sleep. Lack of sleep is closely related to irritability, depressive symptoms, anxiety, and poor coping ability. Vulnerability is exalted by psychosocial pathways. Heatwaves limit day-to-day activities, decrease outdoor socialization, and increase domestic stress. Clayton and Karazsia (2020) define climate anxiety as a new psychological reaction to environmental instability, which implies anticipatory fear and a lack of control. The cumulative stress of exposure to extreme heat can wipe out the resilience in communities repeatedly subjected to extreme heat, especially in areas with limited adaptive infrastructure.

Vulnerable Populations

The psychological distress brought about by heat is not evenly spread. Elderly people and those with already existing psychiatric conditions as well as socioeconomically deprived groups are at high risk (Hansen et al., 2008; Williams et al., 2013). Outdoor workers are compoundly exposed to occupational heat stress. New literature reveals that young adults are a vulnerable category. Even though they tend to be more physically strong, young adults (1835 years of age) have transitional stressors, which include employment instability, financial insecurity, and changing social roles (Hayes et al., 2018). These life-stage pressures can be combined with environmental stress, which makes one more prone to anxiety and depression. There are also gender imbalances. The research suggests that, during heatwaves, women are more psychologically distressed because of the burden of caregiving, limited mobility, and indoor heat exposure (Niaz, 2024). Extremes in heat have been recorded to cause more domestic violence in certain settings and it has been associated to gender vulnerability through environmental stress (Hsiang et al., 2013).

South Asia Regional Evidence.

It is well known that South Asia is one of the most climate-sensitive areas in the world with a high population density, agrarian economy, and low adaptability (Eckstein, Künzel, and Schäfer, 2021). According to the IPCC (2022), there will be increased thermal extremes such as harmful wet-bulb temperatures that deteriorate human thermoregulation (Im et al., 2017). Such climatic conditions increase physical and psychological risks. India-based empirical studies prove that there are significant correlations between elevated wet-bulb temperature and elevated depressive symptoms that are especially relevant to rural and low-view groups (Rao et al., 2024). Excessive heat exposure has also been associated with low cognitive and increased stress levels in students in Bangladesh (Rahman et al., 2023). The field research on Sri Lanka shows that the agricultural workers describe irritability,

hopelessness, and conflict with others during periods of extreme heat (Fernando et al., 2022). These results indicate that the structural vulnerability, occupational exposure, and inadequate healthcare infrastructure are factors that influence climate-related psychological distress in South Asia. Regardless of these findings, the responses of regional policy still continue to revolve around the physical health effects. South Asia has heat-health action plans that seldom incorporate any mental health aspect (WHO SEARO, 2023). Thermal exposure is dealt with by community-based cooling centers as well as early warning systems which seldom include psychosocial support services.

Local Evidence: Pakistan

Pakistan is one of the countries that are greatly impacted by climate change (UNDP, 2022). Some regions in Punjab and Sindh have recorded recurring heatwaves above 45 o C, and some are close to the physiological limit on survivability (Pakistan Meteorological Department, 2024; Raymond et al., 2020). Although the prevention of heatstroke and hydration have been the focus of the public health interventions, the psychological aspect of heat exposure is poorly researched. According to Sarfraz et al. (2021), anxiety, depression, and irritability were high in urban and rural communities during heatwave. The rural residents showed a low help-seeking behavior, which was explained by the stigma and inaccessibility to mental health services. According to Niaz (2024), 72 per cent of rural women in Khyber Pakhtunkhwa were subjected to high levels of stresses, 68 per cent anxiety and 56 per cent symptoms of depression during extreme heat events. Psychological impact was moderated by social support and community cohesion, which highlights the contribution of relational resilience.

Mental health reactions in Pakistan are also influenced by culture. As Javed and Khan (2021) emphasize, the stigma of psychological disorders is widespread, and emotional distress is somatized and treated late. Poor housing ventilation, inadequate electricity, and poor access to cooling are infrastructure constraints, which increase exposure and decrease adaptive capacity (Nasir & Tariq, 2021). Farming and daily-wage work based rural livelihoods are contributive factors to occupational susceptibility during extended periods of heat waves.

Methodology

The study was based on cross-sectional design to understand the correlation between exposure to heatwaves and self-mental health among youths aged 18-35 years in rural Pakistan Lahore, The approach was chosen to obtain quantifiable prevalence data of psychological distress In the quantitative part, a sample size of 334 subjects was calculated according to prevalence rates and statistical aspects of the thesis A simple random sampling strategy was employed to minimize selection bias and maximize representativeness. Sampling was done to get eligible people in selected rural union councils and were invited into participation. The structured questionnaires would be given in structured questionnaires filled by the participants themselves or by the researcher in case of lower literacy levels. Quantitative tools used were Generalized Anxiety Disorder-7 (GAD-7) scale in which the anxiety symptoms were assessed, Patient Health Questionnaire-9 (PHQ-9) scale in which the depressive symptoms were assessed and a perceived stress score. The quality of sleep was assessed through the Pittsburgh Sleep Quality Index (PSQI) and the variables of exposure were measured in terms of both length and number of days of heatwave exposure and access to cooling facilities. Heatwave exposure was operationally defined as three or more days of exposure when the temperature exceeded 40 C and access to cooling facilities was measured.

Means, standard deviations, frequencies, and percentages are the descriptive statistics that were used to summarize the demographic traits and mental health indicators. Inferential tests comprised Pearson correlation coefficients to evaluate the correlation between the duration of heatwave and variables of psychological distress. Statistical testing was performed to determine predictors of depression and anxiety with multiple regression models and the correction of the demographic and environmental factors of coping capacity, employment status, gender, age, and access to cooling resources Significance level of $p < .05$ was used. Qualitative data analysis was based on thematic analysis through the six-stage process proposed by Braun and Clarke familiarization with the data, production of initial themes, development of themes, review of themes, definition of themes, and final reporting.

The Institutional Review Board of the Health Services Academy, Islamabad, gave ethical consent to the study, and the participants were provided with elaborate information sheets indicating study goals, research methods, potential risks, and confidentiality terms. Informed consent was given before participation by way of written consent. Confidentiality was ensured by anonymizing all the data, keeping them in a secure location and having them accessed by the research team only. The research followed principles of voluntary participation, non-maleficence and respect of autonomy of the participants during data collection and analysis in terms of collecting measurable psychological outcomes and qualitative aspects of the resilience and vulnerability to heatwave in rural youth adults who experienced the heatwave. By employing a combination of standard psychometric evaluation with qualitative examination, the methodology was designed to record both quantifiable psychological effects and contextual factors affecting resilience and vulnerability of the heatwave-exposed rural young adults.

Results

Table 1 Demographic Characteristics of Participants (N = 334)

Variable	Category	Frequency	Percentage
Gender	Male	102	30.52%
	Female	231	69.16%
	Prefer not to say	0	0%
Marital Status	Single	275	82.33%
	Married	48	14.37%
	Prefer not to say	11	3.2%
Employment	Unemployed	255	76.34%
	Employed	79	23.65%

The sample consisted predominantly of female participants (69.16%), indicating either higher participation among women or greater accessibility during data collection. A large majority were single (82.33%), consistent with the age range of 18–35 years. Notably, 76.34% were unemployed, reflecting substantial economic vulnerability within the rural youth population. This socioeconomic profile is relevant for interpreting later findings, as unemployment and financial instability are structurally linked to psychological distress and reduced adaptive capacity during heatwaves.

Table 2 Descriptive Statistics of Mental Health and Exposure Variables (N = 332)

Variable	Mean	SD	Min	Max	Median
PHQ-9 (Depression)	10.42	4.81	0	26	9
GAD-7 (Anxiety)	9.15	4.23	0	22	10
Stress Score (0–10)	7.07	2.63	0	11	8
Coping Score (0–10)	5.25	2.43	1	11	6
Sleep Quality (PSQI Index)	8.33	3.15	4	17	9
Heatwave Duration (>40°C days/month)	12.4	3.69	5	21	11
Access to Cooling (0–3 Index)	1.18	0.88	0	4	1

The mean PHQ-9 score of 10.42 indicates mild-to-moderate depressive symptoms across the sample. The GAD-7 mean of 9.15 reflects moderate anxiety levels. Stress scores were high (mean = 7.07 on an 11-point scale), suggesting widespread psychological strain. Sleep disturbance was pronounced, with a PSQI mean of 8.33, indicating clinically poor sleep quality. Participants reported exposure to extreme heat for an average of 12.4 days per month, signifying sustained environmental stress. Access to cooling resources was limited (mean = 1.18 on a 0–3 index), underscoring infrastructural vulnerability. Collectively, these statistics reveal a population experiencing significant climate-related psychological burden alongside restricted adaptive resources.

Table 3 Correlation Matrix (Selected Variable Pairs)

Variable Pair	Pearson's r	p-value
Heatwave Duration vs. PHQ-9 (Depression)	0.57	<.001
Heatwave Duration vs. GAD-7 (Anxiety)	0.54	<.001

Variable Pair	Pearson's r	p-value
Heatwave Duration vs. Sleep Quality	0.78	<.001
Coping Score vs. Stress	-0.63	<.001
Employment vs. Coping	0.32	<.001
Cooling Access vs. Anxiety	-0.43	<.001
Age vs. Depression	-0.18	.002

Heatwave duration shows strong positive correlations with depression (r = .57), anxiety (r = .54), and sleep disturbance (r = .78), indicating that prolonged exposure significantly worsens psychological outcomes. The strongest relationship is between heat duration and sleep disruption, reinforcing sleep as a core mediating mechanism. Coping capacity demonstrates a strong negative correlation with stress (r = –.63), suggesting protective effects of adaptive strategies. Employment correlates positively with coping (r = .32), implying economic engagement enhances resilience. Greater cooling access is associated with lower anxiety (r = –.43), highlighting infrastructural importance. Age shows a weak but significant negative relationship with depression, indicating slightly greater resilience among older participants.

Table 4 Multiple Linear Regression Predicting Stress Scores (Model 1)

Predictor	β Coefficient	95% CI	Std. Error	t-value	p-value
Intercept	4.32	(2.15, 6.43)	1.04	4.21	.001
Heat Duration	0.36	(0.27, 0.46)	0.04	7.43	.001
Coping Score	-0.51	(-0.63, -0.39)	0.05	-8.54	.001
Employment	-1.25	(-1.86, -0.62)	0.30	-4.01	.002
Gender (Female)	1.09	(0.41, 1.75)	0.34	3.07	.003

Predictor	β Coefficient	95% CI	Std. Error	t-value	p-value
Age	-0.06	(-0.12, -0.02)	0.04	-2.34	.020

Model Fit: $R^2 = 0.48$; Adjusted $R^2 = 0.49$; $F(6, 327) = 52.11$, $p < .001$
The model explains approximately 48% of variance in stress scores, indicating strong explanatory capacity. Heat duration significantly predicts increased stress (β = .36). Coping capacity shows the strongest protective effect (β = –.51). Employment reduces stress levels (β = –1.25), confirming economic stability as a buffer. Female gender predicts higher stress (β = 1.09), indicating gendered vulnerability. Age shows a small protective effect. Overall, environmental exposure and socioeconomic variables jointly influence stress outcomes.

Table 5 Multiple Linear Regression Predicting Anxiety (GAD-7 scores) (Model 2)

Predictor	β Coefficient	95% CI	Std. Error	t-value	p-value
Intercept	5.54	(3.17, 7.43)	0.97	5.22	.001
Heat Duration	0.34	(0.26, 0.45)	0.06	6.43	.001
Coping Score	-0.47	(-0.62, -0.35)	0.08	-7.54	.001
Employment	-0.87	(-1.82, -0.61)	0.27	-4.06	.002
Gender (Female)	0.97	(0.42, 1.65)	0.31	2.07	.004
Age	-0.04	(-0.12, 0.02)	0.04	-2.14	.096

This model explains 45% of variance in anxiety scores. Heat duration significantly increases anxiety (β = .34). Coping skills significantly reduce anxiety (β = –.47). Employment functions as a protective factor (β = –.87). Female participants report significantly higher anxiety levels. Age does not reach statistical significance in predicting anxiety. These findings confirm that anxiety during heatwaves is shaped by environmental exposure, coping ability, socioeconomic status, and gender. Overall, the results demonstrate that prolonged heat exposure is strongly associated with depression, anxiety, stress, and sleep disturbance among rural young adults. Coping capacity, employment, and

access to cooling resources serve as critical protective factors, while female gender and unemployment increase vulnerability.

Discussions

The paper discussed the psychological effects of heatwaves among rural young adults aged 1835 living in Lahore as a mixed-methods study. The results reveal that long-term exposure to high temperatures is highly related to high rates of depression, anxiety, stress, and sleep disturbance. The findings suggest that heatwaves are not a one-time environmental phenomenon that leads to physical discomfort but is a maintained psychosocial stress factor that disrupts emotional regulation, daily functioning, and well-being.

The results of quantitative analysis demonstrated that there was a high burden of psychological distress among the sample. The participants had mild-moderate levels of depressive symptoms and moderate anxiety as well as high levels of stress. There was a positive correlation between heatwave duration and depression, anxiety and sleep disruption, which validates that the longer heatwave is experienced, the more psychological pressure it inflicts. One of the most important pathways between heat exposure and emotional distress turned out to be sleep disturbance. Low quality of sleep which was caused by the persistence of night heat impaired the ability of the participants to control their emotions and manage them effectively during the day. It seems that the vicious cycle between insomnia and psychological distress makes one susceptible because insomnia makes one irritable, with a lower frustration threshold, and vulnerable to depressive and anxious symptoms.

The social economic conditions were central to the determination of mental health outcomes. The number of unemployed participants was very high, and unemployment was a significant predictor of stress and anxiety. The use of climate-related livelihoods such as outdoor work is relied on by many young adults, and they cannot be safe or suspended during the extreme heat. This instability in income fueled frustrations of helplessness, low self-esteem, and tension within the household. Economic insecurity did not have an influence in isolation but rather interacted with exposure to the environment to exacerbate distress. The vulnerability was aggravated by financial pressure reducing access to cooling devices like fans, air conditioners or alternative sources of power.

Inequalities on the gender front were also eminent. The women participants registered more stress and anxiety than the male participants. Part of this difference could be attributed to cultural norms and domestic responsibility. In the rural areas, women have to spend long periods of time in stuffy households and carry care giving duties irrespective of the weather. Limited movement and autonomy of access to social cooling facilities or medical services can also increase the level of psychological stress. These gender relations imply that effects of climate on mental health are incorporated into larger social framework and norms.

Cooling resources were found to be a significant protective factor. Those who had access to cooling in more significant ways were less afraid, which shows that psychological damage could be alleviated by the infrastructural support. Nevertheless, overall cooling access was low throughout the sample and this represents structural constraints in the form of poor electricity supply and cost. Personal coping methods such as hydrating more, taking a break, and changing the schedule were common although not always enough. Personal adaptation strategies relieved only partially, without the systemic support.

Practical Implications

The results show that heatwaves should not be considered as environmental risks only but as an important source of mental health issues in rural populations. The practical interventions must focus on the inclusion of psychological support in the current systems of climate adaptation and disaster preparedness. The rural primary healthcare facilities should consider the need to include regular screening of anxiety, depression and sleep disturbances during peak heat seasons. Contributing to enhancing the early identification and referral would also help in instances where there is low access to specialized mental health services; training of the community health workers in basic psychosocial first aid would contribute to better-identifying and referring systems.

Interventions based on infrastructure are also highly important. Community cooling centers, especially those in the rural union councils should be increased as a safe haven where people can have heat relief and interact with each other socially. Stable power supply and provision of subsidized cooling systems to the low-income population could greatly alleviate stress associated with their long-term parameters of staying in a hot environment. Since the connection between sleep disturbance and psychological distress is strong, health-related communication to the population should encompass information on how to ensure better nighttime ventilation and low-cost cooling solutions. An important predictor of distress became the economic vulnerability. Climate sensitive workers should be given temporary income support or labor protection by the policymakers during a time of extreme heat. Stable working hours and temperature regulations about working outdoors would reduce physical and mental hazards. There is also the need to have gender-sensitive programming where women are provided with safe access to cooling systems and community support networks.

Mental health stigma is one of the obstacles to help-seeking. Awareness campaigns conducted by local leaders, teachers, and religious leaders at the community level could make a discussion of emotional well-being normal. Acceptance and engagement would be improved through the inclusion of culturally relevant mental health education in climate resilience interventions. In general, the comprehensive responses should include environmental adaptation, economic protection, and easy access to mental healthcare. Rural population is still going to be subjected to compounded climate-related psychological strain without integrated intervention.

Limitations And Future Directions

There are a number of limitations in this study. First, it is cross-sectional and therefore it limits causation. Whereas some important correlations were found between exposure to heatwave and psychological distress, the temporal directionality has not been conclusively determined. To study cumulative effects of repeated heat exposure over time and to investigate long-term mental health paths, longitudinal studies are required.

Second, geographically, the sample was limited to the rural Lahore. Although this emphasis makes the study more context-specific, it restricts the ability to apply the findings to other provinces or urban populations in Pakistan. Multi-site studies would be better representative and could be used to compare regions. Third, self-reported measures were used to determine the psychological outcomes. Even though validated instruments were used, self-report data are prone to response bias, especially in situations where stigma can be a factor to consider in disclosure. The preference of future research should be to include both clinical assessment or mixed data where possible.

Fourth, environmental exposure was evaluated based on reported experience of heatwave mainly based on reported time of experience and not on continuous meteorological data as applied to households. Localized temperature records, humidity measures as well as objective exposure mapping should be combined into future studies to enhance environmental accuracy. Protective resilience factors such as social cohesion, community networks and adaptive infrastructure should be investigated in future studies. There is also need to have intervention studies to assess the effectiveness of cooling centers, income support mechanisms and community mental health programs during heatwaves. Further investigation in adolescent and elder samples would give a more in-depth insight on the climate-related psychological vulnerability throughout the life span.

Conclusion

This paper illustrates that highly experienced heatwave has serious consequences on the mental health of young adults living in rural Lahore. Long spells of hot weather were closely linked with depression, anxiety, stress, and sleep disturbance and unemployment, limited access to cooling, and gender-related vulnerabilities augmented the psychological pressure. The results indicate that the environment stress is combined with socioeconomic and cultural conditions to generate multidimensional mental health outcomes. It was found that sleep disruption became a key intermediary between heat exposure and emotional dysregulation and that coping capacity was limited by poor adaptive infrastructure. Extreme heat must be known as a physical and psychological public health hazard. Intervention options to tackle the issue of climate-related mental health effects include both infrastructural adaptation and economic protection and community-based mental health provision. It is only with such extensive responses that the vulnerable rural groups will be able to sustain disproportionate psychological burdens as climate change continues to increase.

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