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LONG-TERM PSYCHOLOGICAL CONSEQUENCES OF THE 2020 PETRINJA EARTHQUAKE: A CROSS-SECTIONAL STUDY OF STRESS AND DEPRESSION IN SISAK-MOSLAVINA COUNTY

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ABSTRACT

Background: The 2020 Petrinja earthquake caused widespread destruction in Sisak-Moslavina County, leaving long-term consequences not only on infrastructure but also on mental health of local residents. This study aimed to assess the persistence of stress and associated psychological symptoms five years after the disaster.

Methods: A cross-sectional study was conducted between October and December 2024 using an online questionnaire completed by 300 adult residents (aged 18–70) who had lived in the affected area during the earthquake. The instrument measured perceived stress, anxiety, insomnia, depression, and trauma-related symptoms. Descriptive statistics, one-way ANOVA, Pearson's correlation, and the Mann-Whitney U test were used to analyze group differences and variable associations.

Results: The average stress level was moderate ($M = 3.83$, $SD = 2.40$), with 35% of respondents reporting high stress (scores 6 to 8) even five years after the event. Older adults (from 61 to 70 years) reported significantly higher stress levels than younger age groups ($p < 0.01$). Anxiety and depression scores were consistently high across all age groups ($M = 4.69$ and $M = 4.82$, respectively), with no significant age-related differences. A weak but statistically significant correlation was found between stress and depression ($r = 0.13$, $p = 0.027$), while no significant association was observed between stress levels and seeking professional psychological help ($p = 0.447$).

Conclusions: Five years after the Petrinja earthquake, psychological distress persists among a considerable portion of

the population. Tailored psychosocial interventions, especially for older adults, are essential to reduce long-term mental health burdens.

Keywords: Earthquake trauma, psychological stress, older adults, long-term mental health outcomes.

INTRODUCTION

On December 28 and 29, 2020, two powerful earthquakes struck Sisak - Moslavina County, leaving long-term consequences for both population and infrastructure. The first earthquake, with a magnitude of 5.2 MW (moment magnitude), occurred on the morning of December 28, while the second, stronger one (6.4 MW), hit the area on December 29 at 12:19 p.m., with the epicenter near the town of Petrinja (1). These earthquakes, known as the Petrinja earthquakes or Banovina earthquakes, caused extensive material damage, destroying thousands of homes, businesses, hospitals, and schools, and significantly reducing the quality of life in the affected region. Beyond physical destruction, disasters such as earthquakes also have far-reaching emotional and psychological effects that may persist for years after the event (2).

Natural disasters, particularly earthquakes, are extreme stress-inducing events that disrupt daily life, cause loss of safety, and evoke feelings of helplessness (3). Although immediate rescue and recovery efforts often proceed swiftly, long-term

consequences may include uncertainty regarding home reconstruction, financial hardship, job loss, and the need to adjust to new living conditions (4). Additionally, the devastating effects of earthquakes can impact the socioeconomic stability of the region, limiting access to healthcare, education, and essential services (5).

From a psychological perspective, traumatic events such as earthquakes can elicit a range of emotional responses among individuals and communities (6). While some people adapt successfully and develop coping mechanisms, others may experience prolonged symptoms of stress, including anxiety, depression, insomnia, and post-traumatic stress disorder (PTSD) (7,8). Particularly concerning is the emergence of chronic distress and persistent fear, which can impair quality of life and functional capacity for years. Vulnerable groups such as children, older adults, and individuals with pre-existing psychological conditions are especially affected and may require additional support. Fear of future earthquakes, known as seismophobia, can further impact daily functioning and adaptation (9).

Evidence suggests that the psychological effects of earthquakes may persist over extended periods. They can persist for five years or more, particularly among individuals exposed to trauma reminders, unstable living conditions, or lacking social support (6,10,11). Long-term effects may include chronic mental health issues, such as depressive symptoms, sleep disturbances, and enduring anxiety (12).

Given that five years have passed since the Petrinja earthquake, it is essential to examine how stress and fear have evolved over time and whether differences exist among various age and socioeconomic groups. While the psychological consequences of natural disasters are typically studied in the early stages of recovery, long-term monitoring and longitudinal studies remain scarce, especially in the context of earthquakes in Croatia.

This study explores current levels of stress and related psychological symptoms among residents of Sisak-Moslavina County and analyzes the persistence or reduction of psychological impacts over time. Understanding the long-term consequences of earthquakes is crucial not only for assessing the mental health burden of disasters (13) but also for developing effective support strategies, strengthening community resilience, and ensuring adequate care for those in need (14,15).

AIM

Aims of this study are as follows: To assess the current level of stress and fear among residents of Sisak-Moslavina County five years after the Petrinja earthquake; To analyze differences in stress levels across age groups; To determine

whether stress levels are associated with seeking professional psychological help following the earthquake; To examine the relationship between stress levels and other psychological factors, particularly depressive symptoms.

RESEARCH HYPOTHESES:

H1: There are significant differences in stress levels among different age groups, with older participants reporting higher stress.

H2: The older population exhibits more persistent psychological consequences (higher stress levels) compared to the younger population.

H3: Participants with higher stress levels are more likely to seek professional psychological help after the earthquake.

H4: Higher stress levels are positively correlated with greater depressive symptomatology.

METHODS

RESEARCH DESIGN

This study employed a quantitative, cross-sectional research design to investigate the persistence of stress, fear, and related psychological symptoms five years after the 2020 Petrinja earthquake. The design enabled the collection of data at a single point in time, providing a snapshot of psychological outcomes among residents of Sisak-Moslavina County. An online survey was used as the primary data collection tool, allowing for efficient distribution, accessibility, and the inclusion of a broad demographic range of participants. The cross-sectional approach was chosen for its suitability in identifying associations between psychological variables and sociodemographic factors without manipulating study conditions.

STUDY DESIGN

This study was conducted using an online survey distributed to residents of Sisak-Moslavina County. The questionnaire included demographic data and assessed perceived stress, fear, anxiety, insomnia, depression, false sensations of tremors, and reactions to sudden sounds.

PARTICIPANTS

A total of 300 participants from Sisak-Moslavina County took part in the study. All participants had been living in the area affected by the 2020 earthquake. The average age of respondents was 43.8 years (SD = 14.2), with an age range from 18 to 70 years. The sample consisted of 62% women (n = 186) and 38% men (n = 114).

INSTRUMENTS

A specially designed online questionnaire was used to collect data for this study. The instrument consisted of several sections:

- Sociodemographic data: Participants provided information on age, gender, education level, employment status, and place of residence.
- Perceived stress and fear related to the earthquake: Respondents rated the intensity of stress and fear caused by the 2020 earthquake on a numeric Likert-type scale ranging from 0 (no stress/fear) to 8 (extremely high stress/fear).
- Psychological symptoms: This section included items assessing anxiety, insomnia, depressive mood, phantom tremor sensations, and hypersensitivity to noise. Each symptom was rated on a 5-point scale ranging from 1 (never) to 5 (very often).

The instrument was pilot tested on a group of 15 individuals to verify the clarity and reliability of the items. Internal consistency of the subscales was assessed using Cronbach's alpha, with values ranging from 0.72 to 0.85, indicating acceptable reliability. The questionnaire is freely available and permitted for use in academic research.

INCLUSION AND EXCLUSION CRITERIA

The selection of participants was based on predefined inclusion and exclusion criteria to ensure the relevance and reliability of the collected data. These criteria are presented in Table 1.

Table 1. Inclusion and exclusion criteria for study participants

Inclusion Criteria	Exclusion Criteria
Age between 18 and 70 years	Individuals younger than 18 or older than 70 years
Residence in Sisak-Moslavina County during and after the 2020 earthquake	Individuals who did not reside in the county during the earthquake
Voluntary consent to participate in the study	Refusal to participate or lack of informed consent
Ability to complete the online questionnaire	Inability to understand the questionnaire language or technical limitations

DATA COLLECTION PROCEDURE

Data were collected between October and December 2024 using an online survey created via Google Forms. The invitation to participate was distributed through the following channels:

- Social media platforms (local Facebook groups and forums),
- Emails sent through networks of local associations and institutions (e.g., primary healthcare centres, civil protection organizations),
- Posters and notices placed in public institutions (libraries, healthcare centres).

Participation was voluntary, and respondents accessed the questionnaire via a link. At the beginning of the survey, participants were provided with a clear statement about anonymity and informed consent. Only those who agreed to the consent form were allowed to proceed with the questionnaire. No personally identifiable information was collected.

ETHICAL CONSIDERATIONS

The research was conducted in accordance with ethical guidelines, ensuring participant anonymity and data confidentiality. Participation was voluntary and unpaid. Before participation, individuals were informed about the objectives of the study and data processing procedures and were required to provide electronic informed consent. The study did not require formal ethical approval, as it involved anonymous, voluntary participation through an online questionnaire and did not collect any sensitive or personally identifiable data. The research was conducted in accordance with the ethical principles of the Declaration of Helsinki (16). All participants provided electronic informed consent prior to participation.

SAMPLE BIAS AND LIMITATIONS

Potential bias includes selection bias, as participation was based on voluntary response to an online survey, which may limit the generalizability of the results to the entire population of the county. In addition, the retrospective self-assessment of psychological states (stress, fear, anxiety) may be subject to recall bias and subjective interpretation.

STATISTICAL DATA ANALYSIS

Data were analysed using SPSS software (version v. 27.0), employing descriptive, inferential, and multivariate statistical methods. Descriptive statistics were used to calculate means, standard deviations, and variable distributions. Differences between age groups were analyzed using one-way ANOVA followed by Tukey HSD post hoc tests. Pearson's correlation was applied to assess the relationship between stress and other psychological variables, while the Mann-Whitney U test was used to compare stress levels between participants who had sought professional help and those who had not. Statistical significance was set at $p < 0.05$.

RESULTS

BASIC DESCRIPTIVE STATISTICS

The total sample included 300 participants (62% women, 38% men), aged between 18 and 70 years ($M = 43.8$, $SD = 14.2$). All participants had resided in the Sisak-Moslavina County during the 2020 earthquake and completed the questionnaire in full. Based on age, participants were categorized into four groups: young adults (18–30 years), early middle-aged adults (31–45 years), late middle-aged adults (46–60 years), and older adults (61–70 years).

The study was conducted on a sample of 300 respondents, with complete data collected for all variables. Table 2 presents the main descriptive indicators for key psychological variables, including stress levels after the earthquake, anxiety, insomnia, depressive symptoms, and physiological responses such as the subjective sensation of ground shaking and reactions to sudden sounds.

The level of post-earthquake stress was assessed on a scale from 0 (no stress) to 8 (extremely high stress). The average perceived stress level was $M = 3.83$, $SD = 2.40$, indicating considerable variability. While some participants reported little to no stress, others continued to experience high stress levels even five years later.

The average anxiety level was $M = 4.69$, $SD = 0.60$, and the average level of depressive symptoms was $M = 4.82$, $SD = 0.29$, both of which indicate consistently high emotional burden across the sample. Given that these variables were measured on a 5-point Likert-type scale, scores above 4 are typically interpreted as clinically significant and may warrant psychological intervention. These high values, combined with low variability, suggest pervasive emotional distress related to the earthquake.

The average insomnia score was $M = 4.24$, $SD = 2.00$, reflecting greater variability in sleep disturbances. The sensation of phantom ground shaking was reported with an average of $M = 3.87$, $SD = 1.84$, and reactions to sudden or loud sounds had an average of $M = 4.08$, $SD = 1.88$, both showing a wider range of individual differences.

These results suggest that a significant proportion of the population continues to experience psychological and physiological symptoms even five years after the earthquake. While anxiety and depression appear elevated in most participants, other symptoms show more heterogeneous expression.

A stress level of 0 indicates the complete absence of stress, while a score of 8 indicates extremely high stress. Anxiety and depressive symptoms were measured using a scale in which the values are near the upper limit, suggesting a persistently high intensity of these emotions within the population. Insomnia, phantom shaking sensations, and

reactivity to sound show a broader range of responses, indicating heterogeneity in the experience of these symptoms among respondents.

Table 2. Descriptive statistics of the measured variables

Variable	Mean	Standard Deviation (SD)
Perceived stress level after the earthquake	3.83	2.40
Average anxiety score	4.69	0.60
Average insomnia score	4.24	2.00
Average depressive symptoms score	4.82	0.29
Sensation of phantom ground shaking	3.87	1.84
Reaction to sudden or loud sounds	4.08	1.88

Overall, the data indicate that even five years after the earthquake, a considerable number of participants continue to experience stress, sleep disturbances, and other psychological symptoms. At the same time, a portion of respondents reported low current stress levels, suggesting that they have recovered from the initial traumatic experience to some extent.

DISTRIBUTION OF POST-EARTHQUAKE STRESS LEVELS

Given that stress level is one of the central variables of the study, its distribution among participants was analyzed in greater detail (Table 2). It was found that 43.7% of participants reported very low levels of post-earthquake stress (scores ranging from 0 to 3), suggesting that these individuals have partially or fully recovered from the initial stress reactions. Within this group, approximately 7.7% of respondents ($N = 23$) reported a complete absence of stress (score 0), while a total of 18.3% had minimal stress levels (scores 0 or 1).

On the other hand, just over half of the sample (56.3%) continued to experience moderate to high levels of stress (scores between 4 and 8). Particularly concerning is the finding that 11% of participants reported the highest possible stress score (8), indicating persistent and extremely elevated stress in this subgroup. These results clearly show that although some individuals have managed to reduce or overcome earthquake-related stress, a significant portion of the population still experiences long-term effects in the form of elevated stress.

Table 3. Frequency distribution of post-earthquake stress levels

Stress Level	Frequency (N)	Percentage (%)
0 (no stress)	23	7.7%
1–3 (low stress)	85	28.3%
4–5 (moderate stress)	87	29.0%
6–8 (high stress)	105	35.0%
Total	300	100%

As shown in Table 3, participants were distributed across the entire stress scale, ranging from those without any symptoms of stress to those experiencing the most severe forms. In other words, more than one third of respondents (35 percent) continue to suffer from high levels of stress (scores 6 to 8), while approximately two fifths (around 36 percent) fall within the category of low or no stress (scores 0 to 3). This distribution highlights the heterogeneity of post earthquake experiences. While some individuals exhibit greater psychological resilience or have gradually recovered over time, a substantial portion still bears the burden of elevated stress years after the traumatic event.

DIFFERENCES IN STRESS LEVELS ACROSS AGE GROUPS (HYPOTHESIS TESTING H1)

One of the objectives of this study was to determine whether significant differences in post-earthquake stress levels exist among different age groups. It was hypothesized that older participants would report higher levels of stress (hypothesis H1). To examine this, a one way ANOVA was conducted with age group as the independent factor and post-earthquake stress level as the dependent variable. Table 3 presents the mean stress scores for each age group.

The ANOVA results indicated a statistically significant difference in stress levels across age groups, $F(3, 296) = 4.12, p < 0.01$. Older participants, particularly those aged 61 to 70, reported the highest average stress levels ($M = 4.53, SD = 2.60$). In contrast, the lowest average stress level was found in the youngest group aged 18 to 30 years ($M = 3.42, SD = 2.21$).

Post hoc analyses using the Tukey HSD test revealed that the oldest age group (61 to 70 years) experienced significantly higher stress levels compared to the young adult group (18 to 30 years) and the middle adult group (31 to 45 years), with mean differences of $M = 2.84$ and $M = 2.41$ respectively (p less than 0.001). Furthermore, participants in the mature middle age group (46 to 60 years) also reported significantly higher stress levels than both younger groups (18 to 30 and 31 to 45 years; p less than 0.001).

On the other hand, the difference between the two younger age groups (18 to 30 versus 31 to 45 years) was not statistically

significant ($p = 0.542$), indicating comparable stress levels among younger adults. Similarly, no significant difference was observed between the two older age groups (46 to 60 versus 61 to 70 years; $p = 0.208$), although a slight increase was noted descriptively in the oldest group.

This pattern suggests a threshold effect occurring around middle age. Participants older than 45 years tend to exhibit higher levels of residual stress related to the earthquake than those under the age of 45.

Table 4. Differences in Stress Levels Across Age Groups (ANOVA Analysis)

Age Group	Mean Stress Level (Mean)	Standard Deviation (SD)
Young Adulthood (18–30 years)	3.42	2.21
Middle Adulthood (31–45 years)	3.89	2.35
Mature Adulthood (46–60 years)	4.10	2.50
Older Adulthood (61–70 years)	4.53	2.60

The findings confirm Hypothesis H1, as statistically significant differences in stress levels were observed among different age groups. Older participants, particularly those aged 61–70, reported significantly higher levels of post-traumatic stress five years after the earthquake compared to younger respondents, who had lower average stress levels.

PSYCHOLOGICAL CONSEQUENCES OF THE EARTHQUAKE ACROSS AGE GROUPS (TESTING H2)

Hypothesis H2 was based on the assumption that the older population would exhibit longer-lasting psychological consequences of the earthquake compared to younger individuals. Specifically, it was expected that older participants, in addition to higher stress levels, would also show elevated levels of other post-traumatic symptoms such as anxiety, insomnia, depressiveness, and physiological reactions.

To test this hypothesis, we analyzed differences between age groups across a set of psychological variables. In addition to stress, the analysis included anxiety, insomnia, depressiveness, phantom tremors, and reactions to loud noises. Table 5 summarizes the mean values of these variables across age categories, along with one-way ANOVA test results for each variable.

The results indicate that among all psychological variables examined, only post-earthquake stress shows a statistically significant difference across age groups. As previously described, older participants, especially those in the 61–70 age group, reported

Table 5. Mean Values of Psychological Consequences by Age Group (ANOVA)

Variable	18–30 yrs (M ± SD)	31–45 yrs (M ± SD)	46–60 yrs (M ± SD)	61–70 yrs (M ± SD)	F	p
Post-earthquake stress	2.84 ± 2.34	3.26 ± 2.13	4.82 ± 2.15	5.68 ± 1.95	22.34	< 0.001
Anxiety	4.69 ± 0.60	4.66 ± 0.59	4.69 ± 0.59	4.75 ± 0.63	0.23	0.877
Insomnia	4.14 ± 2.07	4.40 ± 1.99	4.02 ± 1.97	4.51 ± 1.97	0.81	0.490
Depressiveness	4.87 ± 0.30	4.81 ± 0.31	4.75 ± 0.26	4.84 ± 0.24	2.53	0.057
Phantom tremors	3.85 ± 1.78	3.89 ± 1.91	3.89 ± 1.91	3.75 ± 1.84	0.08	0.971
Response to loud noises	4.17 ± 2.03	4.05 ± 1.87	4.04 ± 1.86	3.99 ± 1.63	0.10	0.957

Note: The table displays mean values (M) and standard deviations (SD) for each combination of variable and age group. The bolded row indicates the variable for which a statistically significant age-related effect was observed. For all other variables, no significant differences between age groups were found.

the highest stress levels, while younger groups showed lower average values. This difference is highly significant ($F = 22.34$, $p < 0.001$ for stress in Table 4; note: this F-value refers to the analysis where stress was re-evaluated within a broader set of variables).

In contrast, no statistically significant differences were found for anxiety, insomnia, depressiveness, phantom tremors, or reactions to loud sounds across the age groups (all p-values > 0.05). In other words, anxiety levels, sleep problems, symptoms of depression, and physiological reactions such as sensations of ground shaking or sensitivity to noise were similar across participants regardless of age. All participants reported similarly high levels of anxiety and depressiveness, as well as comparable occurrences of insomnia and physiological symptoms. This suggests that these aspects of post-traumatic difficulties are not age-specific but rather widely distributed across the population.

These findings partially confirm Hypothesis H2. While older participants exhibited significantly higher levels of post-earthquake stress, indicating longer-lasting psychological consequences, no statistically significant age-related differences were found in other symptoms such as anxiety, insomnia, depression, phantom tremors, or reactivity to sound. This suggests that stress may persist longer in the older population, whereas other psychological symptoms appear equally distributed across age groups.

ASSOCIATIONS BETWEEN PSYCHOLOGICAL VARIABLES (ADDITIONAL CORRELATIONAL ANALYSIS)

To gain a better understanding of the interrelations between various psychological reactions following the earthquake, an

additional correlational analysis was conducted, examining the relationships among stress level, anxiety, insomnia, depressiveness, phantom tremors, and reactivity to sounds. Although this analysis was not directly linked to the primary hypotheses, it provides valuable insight into whether these symptoms tend to co-occur or appear independently.

Pearson's correlation coefficients (r) were calculated for all variable pairs (Table 6). Overall, most correlations were not statistically significant, suggesting that the symptoms in question do not necessarily manifest simultaneously. For example, individuals with higher levels of stress did not necessarily report more pronounced anxiety or sleep disturbances.

However, a weak but statistically significant positive correlation was observed between stress and depressiveness ($r = 0.13$; $p = 0.027$). Although the strength of this association is low, the result indicates that individuals experiencing elevated residual stress after the earthquake may also exhibit slightly more pronounced depressive symptoms. In contrast, correlations between stress and the other variables, namely, anxiety, insomnia, sound reactivity, and phantom tremors, were not significant ($p > 0.05$).

Of particular interest is the absence of a significant correlation between anxiety and depressiveness ($r \approx 0.07$; $p > 0.05$), which diverges from typical findings in the literature, where these two variables are usually moderately positively correlated. This unexpected lack of association may be attributable to a ceiling effect i.e., the clustering of scores near the top of the scale, limiting variability. Specifically, the average values for anxiety and depressiveness in this sample were very high (4.69 and 4.82, respectively, on a 1–5 scale), with limited variability. When responses cluster at the upper end of a scale, variability decreases, potentially obscuring true relationships between variables.

Table 6. Pearson Correlation Coefficients Among Psychological Variables

Variable	1. Stress Level	2. Anxiety	3. Insomnia	4. Depress-iveness	5. Phantom Tremors	6. Reactivity to Sounds
1. Stress Level after Earthquake	1	0.052	-0.023	0.128*	-0.050	0.050
2. Perceived Anxiety	0.052	1	0.007	0.073	-0.063	-0.060
3. Perceived Insomnia	-0.023	0.007	1	0.015	-0.056	0.074
4. Perceived Depressiveness	0.128*	0.073	0.015	1	0.018	0.004
5. Phantom Sensation of Tremors	-0.050	-0.063	-0.056	0.018	1	0.045
6. Reaction to Stimulating Sounds	0.050	-0.060	0.074	0.004	0.045	1

The table 6 presents Pearson correlation coefficients (r). Bolded values indicate statistically significant correlations. *p < 0.05.

These findings suggest that post-earthquake stress generally occurs independently from other psychological symptoms, with the exception of a weak association with depressive feelings. While individuals with elevated stress may also experience higher levels of depression, this does not extend to increased anxiety, sleep disturbances, or physiological reactions. The results highlight the complexity of psychological responses, indicating that symptoms such as anxiety and stress may follow different recovery trajectories and are not strongly interdependent.

ASSOCIATION BETWEEN STRESS LEVELS AND SEEKING PROFESSIONAL HELP (TESTING H3)

Hypothesis H3 assumed that individuals with higher levels of stress would be more likely to seek professional psychological help after the earthquake. In other words, it was expected that high levels of persistent stress would motivate individuals to consult professionals (such as psychologists, psychotherapists, or psychiatrists) to cope with the consequences of the trauma.

To test this assumption, participants were divided into two groups: those who sought professional help and those who did not after experiencing the earthquake. Their average levels of post-earthquake stress were compared. Since the variable indicating help-seeking behaviour was not normally distributed (i.e., unequal group sizes) and the groups were independent, the nonparametric Mann–Whitney U test was used to compare stress level ranks between the two groups. The results are presented in Table 7.

Table 7. Comparison of Stress Levels Between Participants Who Did and Did Not Seek Professional Help (Mann–Whitney U Test)

Request for Professional Help	N	Mean Rank	Sum of Ranks	U Statistic
No	97	155.99	15,131.00	
Yes	203	147.88	30,019.00	9,631.00
Total	300			
p-value				0,447

Participants who did not seek professional help had a slightly higher average rank of stress levels (mean rank = 155.99) compared to those who did seek help (mean rank = 147.88). This difference suggests a slight trend indicating that individuals with higher stress levels may be somewhat less likely to seek help. However, this trend is very weak. The statistical analysis showed that the observed difference was not statistically significant (U = 15,131, p = 0.447). In other words, no evidence was found that the two groups differed in terms of stress levels, those who sought professional help did not have significantly higher or lower stress levels than those who did not.

The Mann Whitney U test is a nonparametric equivalent of the independent samples t test. No statistically significant difference was found in stress levels between participants based on whether they sought professional psychological help.

The results do not support Hypothesis H3, as no significant association was found between stress levels and seeking professional psychological help. Despite expectations, individuals with higher stress did not appear more likely to pursue support. This suggests that help-seeking behaviour may be influenced more by factors such as stigma, access to services, or personal coping strategies than by stress intensity alone.

DISCUSSION

The aim of this study was to assess long-term psychological consequences of the 2020 earthquake in Sisak-Moslavina County, with a focus on stress levels, age-related differences, help-seeking behaviour, and symptom interrelations. The main finding indicates that older participants continue to experience significantly higher levels of residual stress even five years after the event, highlighting the persistent impact of trauma in this age group.

The results of this study provide insight into the long-term psychological consequences that the 2020 earthquake had on the population of Sisak-Moslavina County. The objectives of the research were to assess the current level of stress and fear five years after the earthquake, analyze differences among age groups, examine the association between stress and seeking professional help, and explore the relationship between stress and other psychological factors, particularly depression. The study assumed that older respondents experience longer-lasting psychological consequences compared to younger individuals (H1 and H2), that higher levels of stress increase the likelihood of seeking professional help (H3), and that higher levels of stress are associated with a higher degree of depressive symptoms (H4).

The results confirm Hypothesis H1, namely the existence of significant differences in stress levels among different age groups. Older participants (aged 61–70) reported significantly higher levels of stress compared to younger groups, indicating a potential long-term vulnerability of the elderly population to the consequences of traumatic events. These findings are consistent with previous research showing that older individuals may have reduced capacities for stress recovery and less access to effective coping strategies compared to younger people (10,11).

Furthermore, Hypothesis H2, concerning longer-lasting psychological consequences of the earthquake among the elderly population, was partially confirmed. Older respondents (aged 61–70) reported significantly higher stress levels compared to younger participants, suggesting a prolonged impact of the earthquake on their mental health. However, other psychological variables such as anxiety, insomnia, depressive symptoms, phantom sensations of ground shaking, and heightened reactions to sudden sounds did not show significant differences among age groups. These results

indicate that while older respondents have elevated stress levels, other psychological symptoms are not necessarily more pronounced in this population, which may point to the role of individual coping strategies and social support in mitigating these symptoms.

Previous studies confirm that older adults may be particularly vulnerable to post-traumatic consequences, especially in terms of developing post-traumatic stress disorder (PTSD) and adjustment disorders following natural disasters (10). On the other hand, some studies suggest that the elderly population may have a lower prevalence of PTSD compared to younger individuals after man-made disasters (11). Differences in findings may be explained by specific vulnerability factors, including social isolation, physical frailty, and limited access to psychosocial support.

Additionally, studies examining the impact of earthquakes on mental health have shown that living in areas with higher earthquake intensity increases the risk of anxiety, depression, and sleep disorders, with family losses and impaired physical health being key factors in the development of such problems (17). Government interventions and strategies for providing psychological support can play a significant role in mitigating the long-term negative effects of earthquakes, highlighting the need for timely response and strengthening the resilience of the older population.

Meaghan O'Donnell and David Forbes (2016) emphasize that older individuals, due to their physical and social vulnerability, often face greater difficulties in adapting after natural disasters. Their commentary in *International Psychogeriatrics* highlights the need for specialized mental health support programs for the elderly to reduce the risk of long-term psychological consequences. They also warn that with the increasing frequency of extreme weather events and natural disasters, as projected by the Intergovernmental Panel on Climate Change (IPCC, 2014), older adults are expected to be increasingly exposed to such stressful events (18).

The study conducted by Digunović in 2022 showed that, although participants experienced emotional difficulties during the pandemic and after the earthquake, more than 30% were not willing to seek professional help (19). This points to the existence of barriers such as stigma and lack of information about available services, which may prevent individuals from seeking necessary support. Similarly, the study by Keskin and Yurt (2024) on the mental health of emergency medical personnel who responded during the Izmir earthquake (2020) found that high levels of anxiety and negative self-cognition were associated with a greater need for support, while religious coping appeared to act as a protective factor (20). Furthermore, research conducted by Elser et al. in Oklahoma between 2010 and 2019 indicated a correlation between frequent human-induced earthquakes and an increased number of visits to healthcare facilities for stress-related disorders, although no significant association was found with anxiety disorders in a broader sense (21).

In addition, a systematic review by Rowe and Nadkarni in 2023 identified key obstacles in the implementation of mental health programs following natural disasters in developing countries, including cultural barriers, lack of resources, and stigma associated with mental disorders (12). These findings further underscore the need to develop strategies aimed at improving access to and acceptance of professional psychological assistance, especially during crises.

The results of the analysis did not confirm Hypothesis H3, which posited that respondents with higher levels of stress would be more likely to seek professional help after the earthquake. The absence of a statistically significant association between stress levels and help-seeking behaviour suggests that the decision to seek professional psychological assistance is influenced by other factors that may transcend the perceived level of stress. Overall, the findings indicate that help-seeking is not solely linked to stress intensity but is shaped by complex factors, including individual and social barriers, service accessibility, and personal coping mechanisms. Future research should focus on clarifying these relationships and developing more effective strategies to encourage timely help-seeking.

The lack of association between stress and seeking professional support may be explained by cultural and practical barriers. Mental health stigma, especially in smaller communities, may deter individuals from pursuing assistance, while others may be unaware of available services or may not perceive their symptoms as severe enough. Additional obstacles include limited access to professionals, a shortage of therapists, and long waiting periods, particularly in earthquake-affected areas. Moreover, some individuals may develop their own coping strategies, relying on family support or personal adjustment mechanisms. These findings highlight the need to reduce stigma and improve the availability of psychological care.

Correlation analysis showed a significant but weak positive association between stress and depressive symptoms, meaning that individuals reporting higher levels of stress also showed slightly higher levels of depression. Other psychological variables, including anxiety, insomnia, phantom sensations of tremors, and hypersensitivity to sudden noises, were not significantly associated with stress. This suggests that while stress may be a risk factor for depression, it does not necessarily lead to other psychological symptoms, which is important in the context of planning psychosocial interventions.

PRACTICAL AND THEORETICAL IMPLICATIONS

The findings highlight the need for long-term psychosocial support for the elderly, who continue to experience elevated stress levels. Tailored interventions such as support groups, stress-reduction education, and improved access to mental health services are recommended.

Despite high stress, many individuals did not seek professional help, suggesting barriers such as stigma, lack of awareness, or

limited-service availability. This underscores the importance of public education campaigns and improved mental health infrastructure, especially in rural areas.

Given the heterogeneity of psychological responses, support should be individualized, with emphasis on coping strategies and resilience-building. The study confirms that psychological effects persist years after the disaster, particularly among older adults. However, stress alone does not predict help-seeking, calling for further research on factors that influence demand for mental health services.

Future studies should apply longitudinal designs to track psychological changes over time and inform more effective disaster-response planning.

STUDY LIMITATIONS

Several limitations must be acknowledged: Self-report measures may introduce subjective bias, the online survey design may have excluded certain population groups, limiting generalizability, and the cross-sectional approach prevents causal inference, and sociodemographic variables (e.g., gender, education, employment) were not fully analyzed; future studies should incorporate these into multivariate models to identify vulnerability patterns.

CONCLUSION

Five years after the 2020 Petrinja earthquake, older adults (61–70 years) exhibited significantly higher stress levels compared to younger age groups, confirming the hypothesis of age-related differences in perceived stress. A weak but statistically significant correlation was observed between stress and depressive symptoms, underscoring the need for targeted, long-term psychological interventions. No association was found between stress and seeking professional help, suggesting potential barriers such as stigma or limited access to services. These findings highlight the importance of sustained psychosocial support for vulnerable populations and contribute to a deeper understanding of the enduring mental health consequences of natural disasters in the Croatian context.

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