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ORIGINAL PAPER

Psychological resilience and post-traumatic stress disorder as serial mediators between social connectedness and quality of life among individuals exposed to 2023 Kahramanmaras earthquakes

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Abstract
This research investigates the effects of social connectedness, psychological resilience, and post-traumatic stress disorder on the quality of life among those affected by the 2023 Kahramanmaras earthquakes in Türkiye. Surveys were conducted with 207 university students directly or indirectly impacted by the disaster. The relationships between these factors were analyzed using structural equation modeling. The findings indicated that social connectedness had a significant direct effect on psychological resilience, post-traumatic stress disorder, and quality of life. Additionally, psychological resilience negatively influenced post-traumatic stress disorder, while post-traumatic stress disorder had a significant negative effect on quality of life. The analysis also uncovered indirect effects, demonstrating that psychological resilience and post-traumatic stress disorder mediated the link between social connectedness and quality of life. The findings have important implications for disaster recovery efforts, suggesting that interventions should focus on fostering individuals' sense of belonging by building meaningful relationships for better recovery outcomes.

Keywords Earthquake · Post-traumatic stress disorder · Resilience · Social connectedness · Quality of life

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1 Introduction

On February 6, 2023, Türkiye's southern region was struck by two major earthquakes within hours. The first, a 7.5 magnitude quake (Mw = 7.6), hit Kahramanmaras at 4:17 AM. Nine hours later, a second earthquake of 7.4 magnitude (Mw = 7.7) struck near Gaziantep, about 100 km south. Known as the Kahramanmaras Earthquakes, these events affected over 15 million people, causing widespread destruction across 11 cities and over 50,000 fatalities, marking it as one of Türkiye's most severe recent disasters (Göksel et al. 2024). Natural disasters like earthquakes cause not only physical destruction but also severe psychological impacts. These impacts include feelings of helplessness and disorientation due to personal loss, injury, or destruction of homes (Aslam and Tariq 2010). These traumatic experiences often trigger long-term emotional responses, as survivors grapple with the aftermath and strive to rebuild their lives (Knez et al. 2018). Disasters can lead to a wide range of psychological effects such as depression, anxiety etc. (Bonanno et al. 2011). However, PTSD is frequently used as a representative indicator of trauma-related distress (Bonanno et al. 2006). This is largely because it encompasses core symptoms such as intrusive memories and avoidance, which are commonly observed in trauma survivors. PTSD can also manifest as chronic distress, anxiety, and recurring trauma-related symptoms. Therefore, this study focuses on PTSD while acknowledging that disaster impacts are multifaceted and extend beyond PTSD. Beyond aforementioned psychological challenges, survivors' overall life quality is shaped by social and emotional factors, including the strength of their social networks and resilience. Researches highlight factors affecting individuals' life quality in disaster survivors (Kim et al. 2022; Lee and Kim 2024; Li et al. 2020). Among these factors, the direct and indirect impact of social connectedness (SCS), resilience (RES), and post-traumatic stress disorder (PTSD) on the quality of life (QOL) of individuals directly or indirectly exposed to the 2023 Kahramanmaras earthquakes forms the subject of the current study.

Social connectedness is one of the five empirically supported intervention principles identified by Hobfoll et al. (2007) as essential for promoting recovery following disasters, alongside safety, calming, efficacy, and hope. Hence, fostering connectedness is considered a key preventive measure in the immediate and mid-term post-trauma periods. Social connectedness is also crucial for resilience and well-being across various groups and situations. Çiçek (2021) found that social connectedness and support helped mediate the link between hope and resilience, highlighting the importance of social ties in overcoming adversity. Similarly, Rustamov et al. (2023) found that strong social ties significantly enhanced resilience and mental well-being, especially during challenging times. Together, these studies emphasize social connectedness as a key factor in building resilience, which is essential for recovering from trauma. Beyond resilience, social connectedness helps reduce trauma effects, such as PTSD. For instance, Flack and Kite (2021) observed that Australian veterans with strong social ties experienced less psychological distress and lower PTSD symptoms during their transition to civilian life. This protective effect is particularly important in disaster situations, where strong social connections support mental health and aid in processing trauma. Social connectedness also greatly influences quality of life, especially through its impact on relationships. Kuczynski et al. (2020) showed that social ties were strongly linked to quality of life. Similarly, Dorji et al. (2017) found that social connectedness positively affected individuals' physical and mental health. Rustamov et al. (2023) further noted that social ties promote mental well-being by enhancing belonging, support, and community involvement. This interconnectedness among social bonds,

resilience, and mental health suggests that fostering social connections could be a valuable strategy for improving overall recovery and well-being.

Resilience refers to the ability to bounce back or recover to a previous level of functioning after experiencing stress or adversity (Smith et al. 2008). In recent years, the concept of psychological resilience has received growing attention in the field of natural disaster studies. Especially after natural disasters, researchers have sought to understand the factors that enable some individuals to cope successfully (Bonanno et al. 2024, 2011). The ability to remain psychologically resilient after natural disasters can vary from person to person. While some people can be resilient immediately after a disaster, others may not be resilient even after a long time. (Bonanno 2008).

Research consistently links psychological resilience to reduced PTSD symptoms. For instance, Liu et al. (2023) found that resilience, along with social support, significantly reduced burnout and PTSD symptoms among healthcare workers during the COVID-19 pandemic. Zhai et al. (2015) observed similar benefits of resilience in lowering PTSD symptoms in adolescents exposed to trauma in Liaoning, China. Earthquake-related studies support these findings: Wang et al. (2010) reported a strong negative correlation between resilience and PTSD in Chinese earthquake survivors, while Lei et al. (2012) found lower PTSD symptoms among Wenchuan earthquake survivors with higher resilience scores. Additionally, Cénat and Derivois (2014) confirmed resilience's positive impact on mental health in Haitian earthquake survivors. Together, these studies underscore resilience's critical role in mitigating PTSD symptoms.

Studies consistently show that PTSD negatively impacts quality of life. For instance, Noda et al. (2024) found that PTSD symptoms were linked to lower quality of life in emergency workers, while Li et al. (2020) observed similar effects in individuals with spinal cord injuries from the Wenchuan earthquake. Çitak and Dadandi (2024) studied the Kahramanmaras earthquakes and found that PTSD was associated with reduced quality of life. Ulusoy et al. (2024) also noted that PTSD symptoms severely impacted the quality of life among Kahramanmaras earthquake survivors, identifying key risk factors like loss of a loved one and fear of future quakes. Additionally, Yilmaz et al. (2024) linked personality traits, such as conscientiousness and physical injury, to PTSD symptoms and decreased quality of life after the earthquake. Chen et al. (2025) reported that intrusive PTSD symptoms, such as intrusive thoughts, significantly lowered the quality of life in mother-adolescent pairs affected by the Wenchuan earthquake. These findings highlight the importance of targeted interventions to address specific PTSD symptoms and improve survivors' well-being.

Research shows that quality of life is vital for long-term recovery and mental health after disasters. Chen et al. (2023) found that high levels of negative life events led to poorer quality of life, particularly in female adolescents, who reported lower social, psychological, and physical health. This underscores the need for targeted psychological interventions for those under chronic stress. Similarly, Mozaffari et al. (2023) found that resilience, mindfulness, and personal values improved quality of life and reduced PTSD symptoms among Kermanshah earthquake survivors. Together, these studies highlight the importance of resilience, social support, and psychological interventions for enhancing earthquake survivors' well-being.

This study examines the relationships between SCS, RES, PTSD, and QOL among university students affected by the 2023 Kahramanmaras earthquakes, using structural equation modeling (SEM). It explores how RES and PTSD mediate the link between SCS and QOL, providing a detailed look at these pathways in a disaster-affected population. While past studies have explored these factors, this research uniquely applies SEM to students

impacted by the 2023 earthquakes, offering insights to support mental health interventions aimed at improving the quality of life for those recovering from trauma. More importantly, the study makes a novel contribution by testing a serial mediation model in which SCS influences QOL sequentially through RES and PTSD. This approach allows for a more nuanced understanding of how interconnected psychological processes shape well-being in post-disaster contexts. The study tests the following hypotheses:

H1 There is a direct relationship from social connectedness to resilience.
H2 There is a direct relationship from social connectedness to post-traumatic stress disorder.
H3 There is a direct relationship from social connectedness to quality of life.
H4 There is a direct relationship from resilience to post-traumatic stress disorder.
H5 There is a direct relationship from post-traumatic stress disorder to quality of life.
H6 There is an indirect relationship from social connectedness to post-traumatic stress disorder through resilience.
H7 There is an indirect relationship from social connectedness to quality of life through post-traumatic stress disorder.
H8 There is an indirect relationship from resilience to quality of life through post-traumatic stress disorder.
H9 There is an indirect relationship from social connectedness to quality of life through resilience and post-traumatic stress disorder.

2 Metarials and methods

2.1 Study design and participants

Face-to-face and online surveys were conducted with Yildiz Technical University students between September and November 2023, approximately seven months after the earthquakes. A convenience sampling method was employed to collect data from students who were directly or indirectly affected by the earthquakes. Participation was open to the students over the age of 18 who agreed to take part voluntarily. The aim was to reach as many eligible respondents as possible during the data collection period. Students with registered addresses in the 11 provinces most heavily impacted by the earthquakes were contacted by phone and invited to participate in face-to-face interviews. To reach those indirectly affected, an online version of the same questionnaire—using the same measurement scales—was created. The online survey link was shared via all university-related social media channels to ensure broad outreach. All participants were assured that their confidentiality would be protected, they could withdraw from the study at any time, and the data would be used solely for scientific research. By the end of the data collection period, responses were gathered from a total of 207 participants.

2.2 Ethical principles of research

The procedure was approved by the ethics committee. Approval from the Yıldız Technical University Social Sciences Ethics Committee was obtained for this study (Date: May 3, 2023, Reference number: 20230502119).

2.3 Measurements

2.3.1 Social connectedness scale

Developed by Lee and Robbins (1995), the Social Connectedness Scale measures the social connectedness level of people through eight items (e.g., I feel disconnected from those around me) on a 6-point Likert scale (1 = agree to 6 = disagree), with higher scores indicating a stronger sense of belonging. Lee and Robbins (1995) validated the scale among U.S. university students, while Duru (2007) confirmed its validity and reliability for Turkish students. In the present study, the internal consistency of the scale was found excellent (Carmines and Zeller 1979), with a Cronbach's alpha coefficient of 0.923.

2.3.2 Brief resilience scale

Smith et al. (2008) created the Brief Resilience Scale to assess psychological resilience using 6 items (e.g., I have difficulty coping with stressful events) on a 5-point Likert scale (from "strongly disagree" to "strongly agree"), with items 2, 4, and 6 reverse-scored. Total scores range from 6 to 30, with higher scores indicating greater resilience. Smith et al. (2008) validated it in U.S. samples, and Doğan (2015) confirmed its validity and reliability among Turkish university students. In this study, the internal consistency of this scale was found good (Carmines and Zeller 1979), with a Cronbach's alpha coefficient of 0.876.

2.3.3 Post-traumatic stress disorder checklist for DSM-5

Weathers et al. (2013) introduced the PTSD Checklist for DSM-5 to identify lasting psychological effects of traumatic events on people, later adapted into Turkish by Boysan et al. (2017). This 20-item (e.g., Over the past months, how much were you bothered by losing interest in activities that previously gave you pleasure?) scale uses a 5-point Likert scale (0 = "Not at all" to 4 = "Extremely") across four factors: intrusions, negative cognition, avoidance, and hyperarousal. Scores range from 0 to 80, with scores above 48 indicating PTSD. The Turkish version is validated and reliable. In the current study, the internal consistency of the PTSD scale was found excellent (Carmines and Zeller 1979), with a Cronbach's alpha coefficient of 0.941.

2.3.4 European health interview survey-quality of life (EUROHIS-QOL) scale

The World Health Organization Quality of Life (WHOQOL) project produced the WHOQOL-100 and its shorter version, WHOQOL-BREF. The EUROHIS-QOL.8, derived from WHOQOL, includes eight items (e.g., How would you evaluate your overall quality of life?) assessing health, quality of life, and physical, psychological, social, and environmental domains on a 5-point scale (1 = most negative to 5 = most positive). Eser et al. (2010) validated the Turkish version, with scores from 8 to 40 indicating overall quality of life.

The Cronbach's alpha coefficient of this scale was found as 0.802, which indicates a good internal consistency (Carmines and Zeller 1979).

2.4 Statistical analysis

Structural Equation Modeling (SEM) was conducted using Maximum Likelihood Estimation to test the significance of direct and indirect relationships among factors. The measured indicators were handled using the item parceling method (Matsunaga 2008). Three parcels per factor were created, summing values for each indicator variable. Despite debates about parceling, it supports model fit (Hapsari and Widhiarso 2023; Russell et al. 1998). Once measurement model results were satisfactory, *SEM* analyzed the structural model. Model fit was evaluated with Hu and Bentler (1999)'s two-index method, using $SRMR \leq 0.09$ and either $NNFI \geq 0.96$, $RMSEA \leq 0.06$, or $CFI \geq 0.96$ as criteria for good fit (Hooper et al. 2008).

3 Results

3.1 Descriptive statistics

Table 1 presents *descriptive statistics* for survey participants. Among them, 58% are male and 42% female. Age distribution shows 14% are 18–20 years old, 59% are 21–23, and 27% are over 23. A majority of the participants (85%) are undergraduate students, while 15% are graduate students. Regarding income, 14% earn less than 10,000₺, 27% earn 10,001–20,000₺, 16% earn 20,001–30,000₺, and 19% earn over 40,000₺. Additionally, 48% of the participants were directly affected by the 2023 Kahramanmaras earthquakes,

Table 1 Descriptive statistics

Characteristic	Label	n	%
Gender	Male	119	58
	Female	88	42
Age	18–20	29	14
	21–23	123	59
	> 23	55	27
Academic program	Undergraduate	176	85
	Graduate	31	15
Monthly household income (TL)	< 10000TL	30	14
	10.001TL-20.000TL	55	27
	20.001TL-30.000TL	50	24
	30001TL-40000TL	32	16
	> 40000TL	40	19
Exposure to 2023 Kahramanmaras earthquakes	Direct	100	48
	Indirect	107	52
Directly exposed to earthquake before	Yes	165	80
	No	42	20

TL: Turkish Liras

while 52% were indirectly affected. Lastly, 80% of the participants stated that they had previously experienced direct exposure to an earthquake, whereas 20% had not.

3.2 Measurement model results

The parcels were created using the random algorithm method (Matsunaga 2008), ensuring balanced item distribution. For SCS (8 items), parcels include 2, 3, and 3 items, respectively. RES (6 items) has three parcels with 2 items each. PTSD parcels contain 5, 7, and 8 items, while QOL parcels include 2, 3, and 3 items. *Skewness* values range from −0.84 to 0.12, and *kurtosis* values from −1 to 0.48, except for QOL_P2 (*kurtosis* = 1.4), indicating no critical normality issues (Yeni et al. 2018).

Exploratory (EFA) and *confirmatory factor analyses (CFA)* were conducted to ensure data suitability, with reliability assessed using *Cronbach's alpha*. *EFA* used *principal axis factoring* with *promax* rotation. The *Kaiser–Meyer–Olkin (KMO)* value was 0.86, and *Bartlett's test* confirmed the correlation matrix was not an identity matrix ($p < 0.01$). *Factor correlations* exceeded |0.32| (Raykov and Marcoulides 2008), and four factors with *eigenvalues* above 1 were identified. Most parcel *factor loadings* were high (above 0.70), explaining 70% of the *total variance*, with loadings ranging from 0.67 to 0.96 (Hair et al. 2010). Based on these results, data was deemed suitable for further analysis.

Next, *CFA* was conducted to evaluate the measurement model for the four identified factors and to verify whether the parcels were correctly associated with their respective factors. Based on Hu and Bentler (1999) 2-index representation approach, the model showed a good fit with the data, with the following values: $\chi^2 = 74.3$ with 48 degrees of freedom ($p < 0.01$), normed $\chi^2 = 1.55$, $RMSEA = 0.052$, $NFI = 0.97$, $NNFI = 0.99$, $CFI = 0.99$, $GFI = 0.94$, and $SRMR = 0.043$. The *factor loadings* in the *CFA* ranged from 0.63 to 0.93, all of which are higher than the recommended value of 0.50 (Hooper et al. 2008). All factor coefficients were determined to be significant, with respect to their values and *standard errors* ($p < 0.01$). Therefore, the convergent validity of the measurement model was confirmed based on the *CFA* results. The R^2 values were also found to be higher than the recommended value of 0.50. Additionally, *Cronbach's alpha* coefficients were all above the recommended threshold of 0.70, indicating good reliability of the data (Nunnally and Bernstein 1994). Since all values were within acceptable ranges and the *factor loadings* were significant and of an appropriate magnitude, the measurement model demonstrated a good fit, and convergent validity was confirmed by the *CFA*.

3.3 Structural model results

Using *SEM*, the model fit indices were $\chi^2 = 77.01$ with 49 degrees of freedom ($p < 0.01$), *normed* $\chi^2 = 1.57$, $RMSEA = 0.053$, $NFI = 0.97$, $NNFI = 0.99$, $CFI = 0.99$, and $SRMR = 0.046$, indicating an acceptable model fit (Fig. 1). Table 2 presents the direct and indirect paths with their statistics. Significant direct effects were observed for SCS on RES (*H1*, $p < 0.01$), PTSD (*H2*, $p < 0.01$), and QOL (*H3*, $p < 0.01$). Additionally, RES significantly impacted PTSD (*H4*, $p < 0.01$), while PTSD negatively affected QOL (*H5*, $p < 0.01$). Using Mplus 6.1 (Muthén and Muthén 1998–2017), bootstrapping with 10,000 resamples confirmed all indirect effects, as bias-corrected confidence intervals excluded zero (Table 2). RES mediated the relationship between SCS and PTSD (indirect effect = −0.19, *H6*, $p < 0.01$). PTSD mediated SCS and QOL (indirect effect = 0.08, *H7*, $p < 0.01$) and RES and QOL (indirect effect = 0.15, *H8*, $p < 0.01$). Finally, RES and PTSD partially mediated SCS and QOL (indirect effect = 0.06, *H9*, $p < 0.01$).

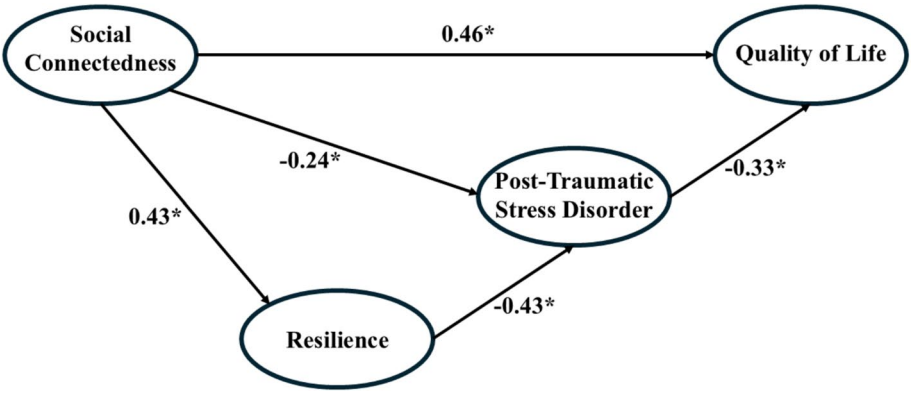


Fig. 1 Structural model. *$p < .01$

Table 2 Estimates of path coefficients with bootstrap confidence intervals

	Path coefficients					Bootstrap confidence interval (95%)*	
	Estimate	Std. Est	Std. Err	*t* value	*p* value	Lower	Upper
Direct effects							
*H1:*SCS → RES	0.29	0.43	0.051	5.67	0.000	0.19	0.39
*H2:*SCS → PTSD	− 0.37	− 0.24	0.129	− 2.86	0.004	− 0.63	− 0.12
*H3:*SCS → QOL	0.19	0.46	0.042	4.41	0.000	0.10	0.27
*H4:*RES → PTSD	− 1.00	− 0.43	0.201	− 4.97	0.000	− 1.40	− 0.62
*H5:*PTSD → QOL	− 0.09	− 0.33	0.027	− 3.25	0.001	− 0.14	− 0.04
Indirect effects							
*H6:*SCS → RES → PTSD	− 0.29	− 0.19	0.076	− 3.824	0.000	− 0.45	− 0.15
*H7:*SCS → PTSD → QOL	0.03	0.08	0.015	2.188	0.029	0.01	0.07
*H8:*RES → PTSD → QOL	0.09	0.15	0.031	2.792	0.005	0.03	0.15
*H9:*SCS → RES → PTSD → QOL	0.03	0.06	0.010	2.545	0.011	0.01	0.05

*Bias corrected (10,000 resamples); Std. Est.: Standardized Estimate; Std. Err.: Standard Error

4 Discussion

The Kahramanmaras Earthquakes on February 6, 2023, devastated southern Türkiye with two major quakes (magnitudes 7.6 and 7.7), affecting over 14 million people and resulting in more than 50,000 deaths. Such natural disasters inflict not only physical damage but also profound psychological impacts, including PTSD, which can reduce survivors' quality of life. This study examines the relationships between SCS, RES, PTSD, and QOL among 207 university students affected by these earthquakes, using structural equation modeling to analyze both direct and indirect effects.

The analysis showed a significant direct effect of SCS on RES, PTSD, and QOL. There was also a significant direct effect of RES on PTSD, and PTSD had a significant negative

direct effect on QOL. Results indicated significant direct effects: SCS positively influenced RES, reduced PTSD, and improved QOL. RES also had a direct negative effect on PTSD, which, in turn, negatively impacted quality of life. Additionally, RES and PTSD served as mediators in the relationship between SCS and QOL, while PTSD mediated between RES and QOL. Moreover, RES mediated the relationship between SCS and PTSD. Finally, PTSD mediated the relationship between RES and QOL.

To the author's knowledge, there are no previous studies in the literature that simultaneously examine the factors of social connectedness, resilience, post-traumatic stress disorder, and quality of life, especially in individuals affected by earthquakes. Moreover, there are no prior findings in the literature regarding each of the indirect effects identified in this study. The only comparable result regarding resilience and post-traumatic stress disorder as serial mediators comes from Cui and Chi (2021), who found that resilience and post-traumatic stress disorder act as serial mediators between social support and internet addiction. This study's findings align with previous research. For instance, our finding that higher social connectedness is associated with increased resilience aligns with Çiçek (2021) and Gizdic et al. (2023), who reported that individuals with stronger social ties tend to cope more effectively after trauma. Similarly, our result that social connectedness improves quality of life echoes previous findings by Dorji et al. (2017), Kleynshteyn (2013), and Nakova and Milenkova (2023), reinforcing the idea that social integration plays a key role in post-trauma recovery. Furthermore, the negative relationship found from social connectedness to PTSD supports the results of Kintzle et al. (2018), Schwartz and Shrira (2019), and Wilkins et al. (2021), who emphasized the buffering role of social bonds in trauma-exposed populations. Regarding the negative relationship from resilience to PTSD, our study confirms earlier studies by Lei et al. (2012) and Wang et al. (2010), indicating that resilience serves as a psychological shield against trauma-related stress. Moreover, consistent with Chen et al. (2025), Çitak and Dadandi (2024), Ulusoy et al. (2024), and Yilmaz et al. (2024), our results support that lower PTSD symptoms are linked to higher quality of life in earthquake survivors.

5 Conclusion

This study contributes to disaster trauma research by examining how social connectedness, resilience, and PTSD impact quality of life. Structural equation modeling revealed both direct and indirect effects, showing that social connectedness improves quality of life both directly and through resilience and PTSD. These findings underscore the importance of addressing psychological and social factors in post-disaster recovery. Mental health practitioners and policymakers should consider interventions that strengthen social ties and resilience to reduce PTSD and enhance quality of life.

6 Implications

A unique contribution of this study is its identification of resilience and PTSD as partial mediators, suggesting that enhancing social connectedness can not only improve quality of life but also strengthen resilience and reduce PTSD among survivors. This insight highlights the importance of fostering social ties as a strategy to support mental health and well-being in post-disaster recovery. Theoretically, findings of this study extend existing trauma-related models by empirically validating a serial mediation mechanism, offering

a more comprehensive understanding of how psychological and social resources jointly shape outcomes after disasters. This contributes to the broader literature by proposing a nuanced pathway through which individual and interpersonal resources interact to affect post-traumatic outcomes.

Practically, the results suggest that interventions aiming to build resilience and reduce PTSD symptoms may be more effective when they also target social connectedness. Examples include peer support groups that promote mutual aid, community-based mental health initiatives that foster belonging, and university-led psychosocial services specifically designed for disaster-affected populations. These programs should integrate culturally relevant components and be sustained over time to support long-term recovery. Such integrated approaches could serve as protective factors in future crises by promoting adaptive coping and improving long-term well-being.

7 Limitations and future directions

This study has limitations. First, it focused only on university students in Türkiye, which may limit the generalizability of the findings to other groups, such as older adults or those with pre-existing mental health conditions. Future studies should examine more diverse populations to assess robustness of the findings across different social and demographic groups. Second, the cross-sectional design restricts conclusions about causality; while relationships among social connectedness, resilience, PTSD, and quality of life were observed, their directional effects remain unclear. Future researches should adopt longitudinal studies to understand these effects over time. Finally, cultural factors unique to Türkiye may affect the findings. Comparative studies across cultures would help clarify the extent to which these findings are culturally bound or universally applicable.

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Declarations

Conflict of interest The authors have no relevant financial or non-financial interests to disclose.

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