Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

Network comparison of post-traumatic stress, anxiety, and mood symptoms in local Turkish and Syrian refugee youth following the 2023 Kahramanmaraş earthquakes

Onat Yetim

onatyetim@gmail.com

Toros University

Lut Tamam

Cukurova University

Ayşegül Efe

Sağlık Bilimleri Üniversitesi

Resul Çakır

Toros University

Gülşen Filazoğlu Çokluk

Toros University

İlham Sebea Alleil

Toros University

Research Article

Keywords: Natural disaster trauma, post-traumatic stress disorder (PTSD), internalizing symptom networks, network analysis, Syrian refugee youth, Turkish host community youth

Posted Date: November 6th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-10059357/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License.
Read Full License

Additional Declarations: No competing interests reported.

Abstract

Previous studies conducted with youth experiencing natural disaster trauma have shown that post-traumatic stress disorder, anxiety, and mood symptoms can follow a complex course; the varying associations between clusters of internalization symptoms may change over time or in a context-specific manner. However, the paucity of studies evaluating relevant symptoms to distinguish between immigrant and local youth necessitates eliminating uncertainty. This study aims to comparatively examine the internalization symptom networks related to natural disaster trauma among Syrian refugee youths with a heavier traumatic burden and Turkish host community youths residing within the same earthquake-affected region. This network analysis study was conducted with a community sample of 3,071 youths aged 14 to 22 years (Turkish: n = 1,845; Syrian: n = 1,226), approximately 1.5 to 2 years after the disaster. The Network Comparison Test (NCT) indicated that the two groups differed in overall network structure. Global strength was significantly greater in the Syrian network, indicating a more densely interconnected symptom network. The Turkish sample showed a strong association between trauma and PTSD symptoms, with mood symptoms such as loneliness, depression, or affective PTSD symptoms being more prominent bridges. In the Syrian sample, a strong association was observed between trauma and symptoms of social anxiety, with the prominent bridge role of depression and anxiety symptom clusters like hyperarousal, social anxiety, and panic/somatic. While trauma is organized in a more typical pattern of PTSD symptoms among Turkish, it is organized in a more complex structure involving a broader network of anxiety symptoms among Syrian.

Introduction

Since the Syrian civil war began in 2011, more than 13 million Syrians have been forced to leave their homes. Turkey now hosts the largest number of Syrian refugees, with over 3.5 million people (1, 2). Children and adolescents, who make up approximately half of this population, have been exposed to multi-layered stressors such as pre-migration violence, hazardous migration conditions, and post-migration challenges, including language barriers, discrimination, and economic hardships (1, 3, 4). Traumatic events experienced before and during the war include witnessing bombings and explosions, the death of a loved one, physical injury, sexual violence, and torture (1, 5, 6). Throughout the migration process, these children and adolescents face additional stressors, including dangerous border crossings, separation from family members, and uncertainty (7, 8). In the post-migration period, post-migration stressors such as language barriers, economic hardships, discrimination, social isolation, and difficulties integrating into the education system exert constant pressure on mental health (9, 10). Particularly in the Turkish context, Syrian refugee youths' interactions with the host community, cultural adaptation processes, and identity conflicts significantly influence mental health outcomes (11, 12).

The Kahramanmaraş earthquakes that occurred on February 6, 2023 (two devastating earthquakes that struck nine hours apart) in southeastern Turkey claimed the lives of approximately 54,000 people, injured approximately 110,000 people, destroyed or severely damaged approximately 300,000 buildings or homes, and affected over 14 million people. This disaster struck the provinces of Hatay,

Kahramanmaraş, Adıyaman, and Adana most severely (13). Studies conducted after the 2023 Kahramanmaraş earthquakes reported elevated post-traumatic stress, depressive, and anxiety symptoms among Turkish youths in the affected regions of southeastern Turkey (14, 15, 16, 17). Turkish youth samples showed probable post-traumatic stress disorder rates of 33.2% and 39.8%. Adolescents referred to psychiatric services during the immediate aftermath of the earthquakes also showed pronounced acute stress reactions (15, 17). Studies show that sleep problems and anxiety often predict more severe PTSD, while support from family can help protect against it (14, 18). Studies also reported enhanced depressive and anxiety symptoms, but most assessed symptom severity rather than the prevalence of clinically diagnosed depressive and anxiety disorders (14, 15, 17).

The 2023 Kahramanmaraş earthquakes have added a new dimension to the pattern of cumulative trauma for Syrian youths. For the approximately 1.7 million Syrian refugees residing in these affected provinces, the disaster has further exacerbated the existing trauma burden (13, 19). In their study involving 1,413 Syrian disaster survivors, Ataya and colleagues (19) found that the prevalence of major depressive disorder rose from 56% to 66.1% following the earthquake, and that sleep problems increased significantly. In another study with a clinical sample of 72 earthquake-exposed Syrian refugee children and adolescents aged 2–17 years, 34.7% were diagnosed with post-traumatic stress disorder (20). Thus, the earthquake experience, added to pre-migration war trauma, the dangers of the migration process, and post-migration daily life challenges, creates a three-layered cumulative trauma profile for Syrian adolescents (14, 21).

Cumulative trauma exposure refers to the combined impact of multiple traumatic experiences that refugee adolescents often face (22). Polyvictimization means being exposed to different types of trauma over a lifetime, which leads to more severe and long-lasting mental health problems than experiencing just one traumatic event (6, 22). Studies show that as the number of traumatic events increases, so does the severity of post-traumatic stress disorder (PTSD) and other mental health symptoms (23, 24). Yektaş and colleagues (22) found that the number of traumatic experiences strongly predicts PTSD, especially when adolescents witness explosions or are exposed to sexual violence. Hinchey et al. (7) also found that, among Syrian and Iraqi youth resettled in the U.S., trauma from assault and having a mother with low social status led to more severe PTSD over time. These results suggest that experiencing more trauma not only raises the chances of developing PTSD but also makes symptoms worse and more likely to last (8, 25). Still, there is not enough research on how cultural and contextual factors affect trauma responses or how trauma patterns differ between groups (26, 27).

Cultural differences between refugees and host communities strongly influence how trauma is experienced, how people respond after trauma, and the ways they cope (26). Choe et al. (27) found that Afghan, Iraqi, and Great Lakes African refugees express trauma and distress in ways that are very different from Western psychiatric ideas. Moses and Holmes (28) showed that refugees from different backgrounds have different views of mental illness. These cultural differences affect not just how symptoms appear, but also how people seek help, what treatments they prefer, and how effective those treatments are (29, 30).

In addition to the findings of studies conducted in Turkey regarding the 2023 Kahramanmaraş earthquakes, the results of studies conducted with Syrian refugee adolescents in various parts of the world show that rates of post-traumatic stress disorder (PTSD) range from 12% to 49%. This wide range is mostly due to differences in how much trauma they have experienced (1, 2). In this group, PTSD often appears alongside depression, anxiety, and behavioral problems. If not treated, PTSD can become long-lasting and seriously affect a young person's development and social life (31). These complex clinical patterns show that traditional ways of diagnosing PTSD, which treat symptoms as signs of a single hidden problem, do not fully explain the differences in symptoms and individual experiences (32, 33).

Because of the limitations of traditional approaches, researchers have turned to network theory, which views psychiatric disorders as systems in which symptoms interact and influence one another (34, 35, 36). In this view, symptoms are active parts of the system, not just signs of an underlying problem. This method helps identify which symptoms are central and which act as bridges between different syndromes (35, 36). For instance, nightmares can lead to sleep problems, which may then cause concentration issues, and these hyperarousal symptoms can result in avoidance behaviors. Network analysis helps prioritize which symptoms to target in treatment by showing which are most important for maintaining system function and which connect different syndromes (37, 38). Longitudinal network analysis shows how symptoms affect one another over time, which helps support stronger causal claims (39). Network models can also show how context sustains mental health problems by including environmental factors such as post-migration challenges, daily stress, and cultural context as part of the system (40).

Syrian youths have faced war, migration, and earthquakes, while Turkish youths have experienced earthquakes and possibly other traumas. Both groups have been exposed to multiple traumatic events, but the type, length, and context of these traumas are different. It is still not clear how these differences affect the links between trauma and internalization symptoms (41). This study aims to compare earthquake trauma and internalization symptom networks in Syrian refugee and Turkish host youths living in areas affected by the 2023 Kahramanmaraş earthquakes. This study notes the traumatic burdens and histories of traumatic experiences among local Turkish youth and Syrian refugee youth. It aims to network comparison of them in terms of clusters of symptoms such as post-traumatic stress (intrusion, avoidance, hyperarousal), anxiety (generalized anxiety, social anxiety, panic/somatic, separation anxiety, school avoidance), and mood symptom clusters such as depression, loneliness, and life satisfaction. The main hypotheses of our study are: (1) Syrian refugee youths will have more connected internalization symptom networks than Turkish host youths following the earthquakes. In other words, cumulative trauma will make the networks denser and central symptoms stronger in Syrian refugee youths. (2) We also expect to find differences in the clusters of internalization symptoms among local Turkish and Syrian migrant youths following the earthquake, particularly in terms of central and bridge nodes. The main aim of our study is to reveal the differences in symptoms between these groups.

Methods

Study participants

The analytic sample consisted of 3,071 adolescents and emerging adults (49.8% female) (Turkish: n = 1,845; Syrian: n = 1,226) aged between 14 and 22 years (Turkish: M = 19.29, SD = 2.11, range 14–22; Syrian: M = 18.12, SD = 2.43, range 14–22). The sample for our study consists of participants from the provinces of Kahramanmaraş, Hatay, and Mersin, which were affected by the Kahramanmaraş earthquakes (for detailed information, see Supplementary Table 1). An exploratory quantitative research design guided the use of a cross-sectional sampling method to recruit youth. Participants were recruited from community centers in collaboration with local NGOs, relying on convenience sampling. Participants aged 14–22 who were literate in their native language and volunteered for the study were included in the data collection. All participants provided informed consent, and parental consent was obtained for participants under 18 years of age. The study protocol was approved by the [Anonymized Institution] Ethics Committee. Data collection was conducted between August 2024 and April 2025. Participants completed a battery of self-report questionnaires in their native language.

According to data from December 2024 released by the Turkish Statistical Institute (TÜİK), Turkey's official statistics agency, the total population of Hatay Province is 1,562,185, while that of Kahramanmaraş Province is 1,134,105 (42). As of January 2025, 218,379 people in Hatay and 107,896 people in Kahramanmaraş continue to live in containers. At the time of the study—approximately 1.5 to 2 years after the earthquakes—13.98% and 9.51% of the total populations in Hatay and Kahramanmaraş, respectively, were living in containers because their homes were destroyed or severely damaged during the earthquakes (43). The current study included 3,071 young people. The number of youth from the provinces of Kahramanmaraş and Hatay who participated in our study is 2.918. 301 young people (Turkish: n = 231; Syrian: n = 70), or 10.31% of the participants from these provinces, were still living in containers at the time of the study. Among youths from Mersin province, which was less affected by the earthquake, no participants were found to be living in containers at the time of the study.

Questionnaires

Potentially Traumatic Events Checklist

The checklist for Potentially Traumatic Events (PTEs) was developed by the researchers according to DSM-5 and ICD-11 criteria, with the study sample in mind. PTEs are assessed using a 24-item structured PTE self-checklist. The PTE checklist follows the definitions of traumatic events in the DSM-5 and ICD-11. It includes items assessing earthquakes (natural disaster), bullying, serious accidents, war, terrorism, physical violence, sexual violence, and medical trauma. This checklist is dichotomous, with binary answer options. Participants can indicate whether they have experienced the event by checking 'yes' or 'no'. Internal consistency of the PTEs checklist was estimated using the tetrachoric correlation matrix to account for its dichotomous items. Reliability was high in both samples (Turkish: ordinal α = 0.91, McDonald's ω = 0.90; Syrian: ordinal α = 0.90, ω = 0.90).

The Children Revised Impact of Event Scale—13 (CRIES-13)

The CRIES-13 is a self-report measure used to screen for PTSD in children and adolescents. The CRIES-13 (44) comprises 13 items across three dimensions: intrusion, avoidance, and hyperarousal. Respondents rate the frequency with which they experienced each item using a 4-point Likert-type scale ranging from 0 (not at all) to 5 (often). An adaptation study of the scale into Turkish was conducted by Çeri et al. (45). In this study, the Cronbach's alpha was reported as 0.85. The Arabic version of the CRIES (46) was used in Chaaya et al. (47)'s study and yielded McDonald's omega (ω) coefficient of 0.92. In the current study, Cronbach's alpha was calculated as 0.81 for the Turkish sample and 0.84 for the Syrian sample.

UCLA Loneliness Scale —6 (ULS-6)

The ULS-6 is a 6-item self-report scale scored on a 4-point Likert scale (1 = Never to 4 = Often), with total scores ranging from 6 to 24 (48). Increasing scores indicate higher perceived loneliness. The Arabic version adapted by Alateeq et al. (49) demonstrated good internal consistency in this study (α = 0.79). An adaptation study of the scale into Turkish was conducted by Sarıçam (50). In this study, Cronbach's alpha scores were reported as 0.77. In the current study, Cronbach's alpha was calculated as 0.74 for the Turkish sample and 0.87 for the Syrian sample.

Screen For Child Anxiety Related Disorders (SCARED)

The SCARED is a 41-item self-report scale that uses a 3-point Likert scale (0 = Not true, 1 = Sometimes true, 2 = Very true or often true), and total scores range from 0 to 82 (51). A score of 25 or higher suggests the presence of clinically relevant anxiety. The Arabic version adapted by Hariz et al. (52) demonstrated good internal consistency in this study (α = 0.86). An adaptation study of the scale into Turkish was conducted by Çakmakçı (53). In this study, Cronbach's alpha ranged from 0.74 to 0.93. In the current study, Cronbach's alpha was calculated as 0.92 for the Turkish sample and 0.87 for the Syrian sample.

Satisfaction With Life Scale (SWLS)

The SWLS is a 5-item self-report scale scored on a 7-point Likert scale (1 = Not at all appropriate, 7 = Very appropriate). An overall score on the SWLS ranges from 5 to 35, with higher scores indicating higher life satisfaction (54). Köker (55) adapted the scale to Turkish culture. In this study, the test–retest reliability coefficient was 0.85. Abdallah (56) adapted the scale to Arabic culture. In this study, the Cronbach's alpha internal consistency coefficient for the scale's total score was 0.79. In the current study, Cronbach's alpha was calculated as 0.80 for the Turkish sample and 0.71 for the Syrian sample.

Kutcher Adolescent Depression Scale —6 (KADS-6)

The KADS-6 (57) is a 6-item self-report scale scored on a 4-point Likert scale (0 = Hardly ever to 3 = All of the time), and total scores range from 0 to 18. Increasing scores indicate a higher severity of depression. The Arabic version adapted by Ammar (58) showed good internal consistency in this study (α = 0.80). An adaptation study of the scale into Turkish was conducted by Tatar and Bekiroğlu (59). In this study, Cronbach's alpha scores were reported as 0.82. In the current study, Cronbach's alpha was calculated as 0.77 for the Turkish sample and 0.74 for the Syrian sample.

Data analysis

Network estimation

We estimated a 12-node Gaussian Graphical Model (GGM) for each group. Nodes comprised the five SCARED subscales (panic/somatic, generalized anxiety, separation anxiety, social phobia, school avoidance), the three CRIES subscales (intrusion, avoidance, hyperarousal), depression (KADS), loneliness (ULS-6), life satisfaction (SWLS), and earthquake exposure as a focal node. To isolate associations net of war-related trauma, all symptom nodes were residualized on war exposure before estimation; earthquake exposure was retained as observed. Networks were estimated with the graphical LASSO regularized using the Extended Bayesian Information Criterion (EBIC, γ = 0.5) (60) on Spearman correlations, which is appropriate for ordinal and non-normal indicators. Edges represent regularized partial correlations. Node predictability was computed as described in Haslbeck and Waldorp (61). Analyses were conducted in R software version 4.3.3 (R Core Team, 2024) using the qgraph package (62).

Centrality

For each network, we computed node strength, expected influence (EI), and bridge expected influence. Bridge centrality (63) was computed by treating the SCARED and CRIES subscales as the two symptom communities, with the remaining nodes as singletons. Following recommendations that EI is among the most stable and interpretable indices in regularized networks (64), interpretations were based primarily on EI and bridge EI; values were also z-standardized within group for comparison.

Network Comparison Test

Between-group differences were tested with the Network Comparison Test (NCT) (65), a permutation procedure assessing (a) overall structure via the maximum edge-difference statistic (M); (b) global strength, the sum of absolute edge weights (S); (c) the invariance of each edge, with family-wise error correction via the maximum-statistic method; and (d) the invariance of node centrality (EI and bridge EI). Edge and global tests used 1.000 permutations, and centrality tests used 2.000 permutations, at α = 0.05. Network stability was assessed with case-dropping bootstraps (correlation-stability, CS, coefficient). As a robustness check against unequal sample sizes, the Turkish sample was randomly downsampled to the Syrian sample size, and the global-strength comparison was repeated. Because the two samples differed substantially in sex composition, two further sensitivity analyses examined

whether the cross-cultural differences were attributable to gender. First, the full network comparison was repeated after additionally residualizing every symptom node on participant gender within each group. Second, in the pooled sample, male and female networks were compared after residualizing for war exposure and culture.

Earthquake-exposure severity as a moderator of network structure

To test whether earthquake exposure conditions the broader symptom network rather than acting as a single peripheral node, the pooled sample was split at each group's median earthquake-exposure score into high- and low-exposure subgroups, and the 11 symptom-node networks were compared via NCT. The contrast was then repeated within each group.

Results

Descriptive Statistics

Descriptive statistics of Syrian and Turkish samples for all scales, subscales, and characteristics of trauma and comparison of all of these characteristics between groups are presented in Supplementary Table 2 and Supplementary Table 3, respectively. Syrian participants reported higher cumulative trauma exposure (M = 4.96, SD = 2.07 vs. M = 3.58, SD = 1.93), anxiety (SCARED M = 55.67 vs. 48.04), and post-traumatic stress (CRIES M = 36.72 vs. 34.46), and lower life satisfaction (SWLS M = 12.52 vs. 17.20; all $p < 0.001$, Mann–Whitney), whereas depression did not differ (KADS M = 16.47 vs. 16.54, $p = 0.195$).

Network Structure and Global Connectivity

The Network Comparison Test indicated that the two groups differed in overall network structure (M = 0.299, $p = 0.001$). Global strength was significantly greater in the Syrian network than in the Turkish network (S = 6.40 vs. 6.00; S-difference = 0.40, $p = 0.014$), indicating a more densely interconnected symptom network among Syrian youths. Network density was 83.3% (55 of 66 edges) in the Syrian network versus 75.8% (50 of 66) in the Turkish network, and the mean absolute edge weight was slightly larger in the Syrian network (0.097 vs. 0.091; Table 1). Both networks were highly stable (CS-coefficient for expected influence = 0.75). The global-strength difference remained when the Turkish sample was down-sampled to the Syrian sample (S-difference = 0.36), indicating that it was not an artifact of unequal sample size.

Edge-level invariance

After family-wise error correction, 22 of the 66 edges differed significantly between groups. The single largest difference involved a loneliness–earthquake edge that was uniquely negative in the Syrian network (− 0.30) and absent in the Turkish network (0.00). Within the post-traumatic stress cluster, the intrusion–hyperarousal (0.42 vs. 0.16) and intrusion–avoidance (0.45 vs. 0.27) edges were substantially stronger in the Turkish network, indicating tighter cohesion of the earthquake-response cluster among

Turkish adolescents. The depression–loneliness edge was likewise stronger in the Turkish network (0.34 vs. 0.15). Conversely, several anxiety-related connections (e.g., social phobia–loneliness, 0.01 vs. 0.18; separation anxiety–social phobia, 0.01 vs. 0.18) were stronger in the Syrian network, reflecting a more interlinked anxiety–interpersonal domain. Network comparison statistics for the Turkish and Syrian youth symptom networks are presented in Table 1.

Centrality differences

Permutation tests of centrality revealed that depression was the strongest bridge node in the Syrian group, and the second strongest node in the Turkish group, and was significantly stronger in the Syrian network (bridge EI = 0.99 vs. 0.67, $p < 0.001$), underscoring the central role of depressive symptoms in linking the anxiety and trauma domains. Social phobia showed higher expected influence and bridge centrality in the Syrian network ($p < 0.001$), and intrusion functioned as an inward node in the Turkish network but as an outward bridge in the Syrian network ($p < 0.001$). By contrast, earthquake exposure occupied a peripheral position in both networks, and its connectivity did not differ significantly between groups (EI difference $p = 0.174$). Loneliness showed higher bridge centrality in the Turkish network (EI = 0.78 vs. 0.19, $p < 0.001$). Differences in networks comparing symptom-network structure between Turkish and Syrian samples are visualized in Fig. 1.

Earthquake-Exposure Severity and Network Density

When the sample was partitioned by earthquake-exposure severity, the high-exposure symptom network was significantly more strongly connected than the low-exposure network ($S = 5.52$ vs. 5.15, $p = 0.007$; structural difference $p = 0.001$). This dose–density pattern held within both groups, global strength increased from 5.32 to 6.10 in the Turkish sample and from 5.84 to 6.83 in the Syrian sample (both $p = 0.001$). Thus, although earthquake exposure was a peripheral node, greater exposure severity was associated with a more densely interconnected symptom network in both populations. Full results of our network analyses are presented in Supplementary Tables 4, 5, 6, 7, 8, 9, and 10.

Sensitivity to Sample Gender Composition

The Turkish and Syrian samples had very different gender compositions. In the Turkish sample, one gender made up 65.1%, while in the Syrian sample, it was 26.8%. Because of this, we considered whether the network differences between the groups were due to gender rather than cultural background. To check this, we adjusted each symptom node for participant gender within each group. After making this adjustment, the cross-cultural differences stayed about the same. The groups still showed differences in structure ($M = 0.281$, $p = 0.003$) and global strength ($S = 5.68$ vs. 6.28; S-difference = 0.60, $p = 0.036$). The differences in edge weights after adjusting for gender were almost identical to those in the main analysis ($r = 0.997$). The same 21 edges still showed violations of invariance after correcting for multiple comparisons. The bridge-centrality pattern also stayed the same. Loneliness was more central in the Turkish network, while depression and social phobia were more central in the Syrian network. The gap in global strength did not get smaller after adjustment; instead, it increased slightly from 0.42 to 0.60.

We also directly compared the two gender groups in the combined sample. We adjusted the symptom nodes for war exposure, and the sample participants came from. The gender groups showed differences in both structure (M = 0.149, p = 0.009) and global strength (S = 5.86 vs. 5.27, p = 0.019). However, these gender differences were smaller than the cross-cultural differences (structural M = 0.149 vs. 0.281) and involved a different set of edges. Only 3 edges remained significant after correcting for gender, compared to 21 edges for the cross-cultural difference. These findings show that gender sex was linked to how symptom networks were organized, but it did not explain the cross-cultural differences. The cross-cultural differences remained and even became slightly stronger after adjustment. The sensitivity of the cross-cultural network comparison to sample sex composition is shown in Supplementary Fig. 1.

Table 1
Network comparison statistics for the Turkish and Syrian youth symptom networks

Variable	Turkish	Syrian	Test statistic	*p*
Network structure (M)	—	—	M = 0.299	< 0.001
Global strength (S)	6.00	6.40	S-diff = 0.40	0.014
Network density (%)	75.8	83.3	—	—
Non-zero edges (of 66)	50	55	—	—
Mean |edge weight|	0.091	0.097	—	—
Largest edge differences				
Loneliness — Earthquake	0.00	−0.30	|Δ| = 0.30	0.001
Intrusion — Hyperarousal	0.42	0.16	|Δ| = 0.26	0.001
Depression — Loneliness	0.34	0.15	|Δ| = 0.20	0.001
Intrusion — Avoidance	0.45	0.27	|Δ| = 0.18	0.001
Social phobia — Loneliness	0.01	0.18	|Δ| = 0.17	0.001
Bridge expected influence				
Loneliness	0.78	0.19	|Δ| = 0.59	< 0.001
Intrusion	−0.15	0.23	|Δ| = 0.38	< 0.001
Depression	0.67	0.99	|Δ| = 0.32	< 0.001
Social phobia	0.20	0.45	|Δ| = 0.25	< 0.001
Panic/Somatic	0.19	0.37	|Δ| = 0.18	0.001
Hyperarousal	0.33	0.48	|Δ| = 0.15	0.002
Earthquake exposure	−0.11	−0.03	|Δ| = 0.08	0.174

Note. Edge weights are regularized partial correlations from a Gaussian Graphical Model (EBIC-tuned graphical LASSO, γ = 0.5). Structure (M) and global-strength (S) tests used 1.000 permutations; centrality tests used 2.000. Edge-level significance reflects family-wise error correction.

Discussion

To the best of our knowledge, this study is one of the first to directly compare the internalization symptom networks of Syrian refugee youths and Turkish host community youths within the same disaster context. Accordingly, this study aims to comparatively examine the symptom networks related to natural disaster trauma among Syrian refugee youths with a heavier traumatic burden and Turkish host community youths residing within the same earthquake-affected region.

Our findings mostly support the hypotheses. We found that the trauma and internalization symptoms network showed higher connectivity among Syrian youths, which matches earlier studies that reported strong network connections and unique centralization patterns among trauma symptoms in refugee youths (66, 67). In graphical LASSO networks estimated using the EBIC model, higher global strength, network density, and edge weights among Syrian youths suggest that trauma (earthquake exposure) and internalization symptoms are more tightly interconnected within this group. The observation of this difference at the general network connectivity level, the most central symptoms, and the specific edge level suggests that cumulative trauma exposure may transform the symptom system into a more integrated and potentially more resilient structure. These results agree with research showing that the symptoms at the center of the network can change depending on the trauma burden and profile of each group (68, 69).

The fact that Turkish youths primarily faced a single traumatic event—namely, an earthquake—while Syrian youths experienced not only repeated traumas such as war and migration but also an earthquake experience constitutes an important contextual distinction that may explain the difference in network architecture between the groups (24). This framework demonstrates that the burden of trauma must be assessed not only by the number of exposures but also in conjunction with the type of trauma, its duration, and contextual accumulation (70).

The findings of Stefanovic and colleagues (71), who compared Type I and Type II trauma networks, also provide an explanatory framework for the current results. Stefanovic and colleagues found that in individuals experiencing Type I trauma, networks exhibited lower density and weaker symptom connections. In contrast, in those experiencing Type II trauma, networks demonstrated higher density and stronger symptom clusters. This pattern aligns with other studies showing that psychiatric symptom networks in different trauma types possess distinct and divergent structural characteristics (72, 73).

Turkish sample

One of the notable findings of our study is that the associations between earthquake exposure and PTSD symptoms are stronger among Turkish adolescents than among Syrian adolescents, and that the interconnections among PTSD subtypes appear more pronounced. In particular, the strong relationships between earthquake exposure and symptoms of hyperarousal and avoidance, along with the close interactions among intrusion, hyperarousal, and avoidance symptoms, suggest that the traumatic experience is largely organized within the PTSD system in this group. Notably, in the Turkish sample, intrusion, hyperarousal, and avoidance symptoms do not play a strong bridging role with other psychopathological domains. When these findings are evaluated together, it can be said that earthquake exposure in Turkish adolescents forms a psychopathological structure that is more specific to PTSD.

In a network analysis study evaluating 635 children and adolescents affected by the 2012 Emilia-Romagna earthquake, 18 months after the event, the relationships between general psychiatric symptom clusters and PTSD symptom clusters were examined. In this study, emotional problems/affective

symptoms, hyperarousal, and avoidance symptoms had the highest centrality values (74). Our study was also conducted within a similar timeframe following the earthquake, and for the Turkish sample, mood symptoms similarly emerged as the most central node.

In a longitudinal network analysis conducted by Ge and colleagues (75) involving 1,623 children and adolescents affected by the 2013 Lushan earthquake, the young participants were assessed during the acute phase, specifically 2 weeks, 3 months, and 6 months after the event. In this study, intrusion symptoms, such as flashbacks, emerged as the most central nodes across all three time periods. In the 3-month assessments, an association between intrusion symptoms and hyperarousal symptoms was observed, while in the 6-month assessments, an association between intrusion symptoms and avoidance symptoms was noted. These results can be explained by the fear-conditioning circuitry (76)—specifically, while hyperarousal symptoms such as heightened sensitivity to threat are initially more strongly associated with the triggering traumatic experience, deficits in fear extinction lead avoidance behavior to play a more central role over time. Associations and reciprocal temporal interactions among PTSD symptom clusters in children and adolescents who have experienced natural disaster trauma have also been observed in other network analysis studies (77, 78).

Exposure to earthquakes is also strongly associated with loneliness among Turkish youths. One of the striking findings of our study is that loneliness emerges as the strongest bridging variable within the psychopathological network among Turkish youths, with depression or affective PTSD symptoms assuming the second most important bridging role. Loneliness exhibits a strong association with depression in Turkish adolescents and serves as a gateway from traumatic experiences to depression or PTSD related mood symptoms.

Furthermore, in the Turkish sample, loneliness served as a bridge linking anxiety disorders and mood symptoms by paving the way for generalized anxiety symptoms and life satisfaction/well-being in association with separation anxiety. In addition, symptoms of depression and social anxiety showed strong associations in the Turkish youth sample. Mood symptoms such as loneliness and depression have served as a bridge linking traumatic experiences to anxiety disorders.

The strong association observed between traumatic experiences and avoidance symptoms in the Turkish sample, along with the prominent bridge role of affective PTSD symptoms such as loneliness and depression, may explain this relationship.

At this point, the short-term function of avoidance-based coping must be considered alongside its long-term risks. While the pattern observed in Turkish adolescents appears consistent with cognitive-behavioral trauma models that acknowledge the short-term adaptive function of avoidance, it is known that avoidance-based strategies increase the risk of PTSD becoming chronic in the long term; longitudinal studies have shown that early avoidant coping in post-earthquake adolescent samples predicts more severe and persistent PTSD symptoms and comorbidities in later periods (79, 80). This finding supports the notion that social withdrawal is not a simple risk factor but a contextual variable shaping the complexity of post-traumatic psychopathology. Therefore, high levels of loneliness or social

withdrawal should be considered a vulnerability area that requires monitoring and intervention in Turkish adolescents.

Kazlauskas et al. (81), in their cross-cultural studies involving adolescent samples from Japan and Lithuania, found that loneliness was the strongest predictor distinguishing comorbidities and complex PTSD from PTSD. Wu et al. (82) followed adolescents in Taiwan after the Chi-Chi earthquake and demonstrated that social relationships significantly predicted the trajectories of PTSD symptoms. This finding indicates that social relationships and contextual conditions may also be decisive for post-traumatic adjustment in single-disaster contexts; longitudinal studies consistently demonstrate that social support is a key protective factor shaping the course of PTSD in adolescents following an earthquake (83, 84).

In a network analysis study conducted by Misitano and colleagues (74) with adolescents who experienced earthquake trauma, emotional symptoms—including symptoms of depression and anxiety disorders such as generalized and social anxiety—emerged as the most central node 18 months after the earthquake and displayed connectivity with hyperarousal, avoidance, intrusion, and peer problems, respectively. The results of this study demonstrate the interconnections between mood disorder symptoms, such as depression and loneliness, and PTSD and anxiety disorders. Previous studies (85, 86) showed that dysphoric or affective symptoms of PTSD served as a strong bridge to depression in adolescents exposed to earthquakes. Our study is based on the ICD-11 (87) definition of PTSD, which focuses on core traumatic symptoms. The similarities or overlaps observed between depression symptoms and the dysphoric or affective symptoms of PTSD, as defined by the DSM-5 (88), help explain the underlying dynamics. A latent profile analysis conducted in a study involving adolescents assessed 1 and 2 years after the Wenchuan earthquake demonstrated that PTSD and depression represent distinct yet frequently comorbid psychopathological constructs (89).

Syrian sample

One of the notable findings of our study is the strong association observed between earthquake exposure and symptoms of social anxiety among Syrian migrant youths. While in the Turkish sample, earthquake exposure—that is, Type 1 trauma—exhibits a strong association with avoidance, hyperarousal, and loneliness, among Syrian migrant adolescents, earthquake exposure is associated with symptoms of social anxiety. Furthermore, social anxiety stands out as a significant bridge node in the Syrian network, following depression and hyperarousal. In Syrian migrant youths, social anxiety serves as a bridge linking earthquake exposure to loneliness and separation anxiety. Although loneliness exhibited quite high connectivity in the Turkish group, its connectivity with social anxiety/phobia was higher among Syrian refugee youth. Several anxiety-related connections were stronger in the Syrian network, reflecting a more interlinked anxiety–interpersonal domain.

Threat-related traumas during childhood are associated with changes in factors such as fear/safety learning, neurobiology, and psychopathology development for adults and youths has been demonstrated

(90). Along with these chronic traumatic processes and neurobiological changes, anxiety may be a more likely outcome than PTSD for cumulative trauma-exposed refugee youths (2, 7). Symptoms of social anxiety are commonly observed among young immigrants, partly due to the influence of post-migration stressors such as experiences of discrimination (91). The fact that social anxiety symptoms act as a risk-enhancing factor for loneliness among traumatized Syrian adolescents suggests that this group's social networks may have been more severely compromised in terms of both quantity and quality. Therefore, interventions aimed at alleviating social anxiety and strengthening social connections among refugee adolescents after an earthquake must focus not merely on increasing the number of social contacts, but on fostering safe, supportive, and sense-of-belonging-providing relationships. In this regard, it is observed that trust-based and resource-oriented intervention approaches are also supported by refugee youth's perspectives (92, 93).

One of the most striking findings of our study is that symptoms of hyperarousal in Syrian migrant youths play a strong bridging role within the psychopathological network, acting as a bridge between panic/somatic symptoms and affective symptoms such as life satisfaction and well-being, thereby facilitating comorbidities. While hyperarousal symptoms in Turkish youths primarily function within the PTSD system and play a relatively limited bridging role, in Syrian youths, these symptoms appear to occupy a more central position, linking different psychopathological domains. In particular, the strong association between hyperarousal and panic/somatic symptoms suggests that a state of chronic physiological arousal may play a significant role not only in the maintenance of traumatic stress symptoms but also in the emergence of broader anxiety symptoms (2, 7, 90). Successive traumatic experiences such as war, forced migration, post-migration hardships, daily challenges, and earthquakes may have caused the physiological alarm system of Syrian youth to remain active for an extended period. Hyperarousal and increased physiological arousal may, over time, pave the way for the development of anxiety disorder symptoms such as panic and somatic symptoms. When these processes are considered together, hyperarousal symptoms in Syrian youths can be viewed not merely as an indicator of traumatic stress responses but as a significant transdiagnostic mechanism linking cognitive, emotional, and behavioral processes.

Network analyses of PTSD in refugee adolescents also show that symptoms of hyperarousal frequently emerge as the central node. Studies using network analysis on PTSD in refugee adolescents often find that hyperarousal and re-experiencing symptoms are central. For example, Pfeiffer et al. (66) found that these symptoms were highly central in refugee youth in Germany, and that group therapy reduced them significantly. Schumacher et al. (68) reported that clinicians saw concentration problems (hyperarousal) and nightmares as especially important to address. Ross et al. (94) showed that hyperarousal and re-experiencing symptoms strongly connect with dissociative symptoms in trauma-exposed adolescents. Kratzer and colleagues (95) examined network connections between PTSD, somatic symptoms, and dissociation in a sample of adult inpatients who experienced childhood trauma and found that physiological reactivity (hyperarousal) was the most central node in the network, serving as a bridge between PTSD and somatic symptoms alongside attention difficulties. This finding supports the notion that cumulative trauma can create a multi-layered symptom network encompassing not only PTSD

symptoms but also clusters of somatic and dissociative symptoms, and hyperarousal serves as a bridge linking various psychiatric symptoms in individuals with a history of cumulative trauma.

The fact that symptoms of anxiety disorders and depression following a natural disaster are more centrally located in the network analysis of young Syrian refugees—who have been exposed to traumatic experiences such as war trauma and the loss of a caregiver—compared to local Turkish youth suggests that the effects of cumulative trauma follow a more complex course. In our study, conducted approximately 1.5 to 2 years after the Kahramanmaraş earthquakes, the Turkish sample showed a strong association between trauma and PTSD symptoms, with mood symptoms such as loneliness, depression, or affective PTSD symptoms being more prominent bridges—which carry a risk of chronicity—and simultaneously exhibiting a more “typical” post-traumatic pattern. In the Syrian migrant youth sample, anxiety disorders such as social anxiety disorder show a strong association with trauma, which plays a more central role alongside mood symptoms like depression or affective PTSD symptoms. The prominence bridge role of depression and anxiety disorders or symptom clusters like hyperarousal, social anxiety, and panic/somatic in the Syrian network suggests that, in addition to PTSD, more comprehensive psychiatric approaches need to be developed for young people with a history of early-onset, cumulative trauma.

Furthermore, our study reveals a link between hyperarousal and avoidance symptoms and life satisfaction among Syrian migrant youth, suggesting that traumatic experiences may affect subjective well-being and daily functioning, and may also pave the way for mood symptoms. Depression plays a leading role as a bridge node in the sample of Syrian migrant youth and exhibits strong associations with intrusion and anxiety symptoms such as school avoidance.

The central node profile in polyvictimized adolescents may not be limited solely to symptoms of re-experiencing, intrusive memories, and hyperarousal. Bridges-Curry and colleagues (69) demonstrated that in a sample of polyvictimized adolescents, dissociation, self-blame, and grief were the most central nodes, and that derealization predicted anxiety symptoms in the later period. This finding suggests that cumulative trauma exposure may also bring depressive symptoms like grief, dissociative, and cognitive symptoms to the center of the network. Furthermore, in addition to major traumatic experiences, the frequency and severity of everyday challenges can also significantly affect the well-being of young migrants (96). Behrendt et al. (97) found that daily challenges like housing, money, and language barriers are directly linked to PTSD and depression in refugees. It has been noted that the discrimination, social isolation, and uncertainty about the future experienced by young people after migration are closely linked to symptoms of depression and PTSD (98, 99).

In our study, although intrusion symptoms exhibited higher bridge characteristics in the Syrian network compared to the Turkish sample, they did not play as central a role as symptoms of depression, hyperarousal, social phobia, and panic in the Syrian network. However, one of the striking findings of our study is that, in the Syrian migrant youth network, intrusion symptoms link PTSD to generalized anxiety and depression symptoms, thereby paving the way for comorbidities.

In a longitudinal network analysis study conducted by Li and colleagues (100) with 3,189 adolescents in China, depression, anxiety disorders, and PTSD were examined together. In this study, two separate assessments were conducted over a follow-up period of approximately 1.5 years. Across all time periods, the most central nodes were panic/somatic symptoms and generalized anxiety disorder symptoms. Sleep problems (hyperarousal symptoms) emerged as the most significant bridge node, followed by other hyperarousal symptoms (irritability, difficulty concentrating). Thus, it was found that the connections between anxiety disorders and PTSD symptoms are particularly strengthened through PTSD symptoms such as hyperarousal. In our study, in addition to hyperarousal symptoms, intrusion symptoms—albeit with lower connection strength—also form the pathway linking generalized anxiety disorder and depression. Intrusive or intrusive traumatic thoughts can lead to rumination—that is, excessive preoccupation with these thoughts. Rumination can show unique network associations with re-experiencing symptoms (intrusion) and negative alterations in cognition and mood nodes in youths and adults exhibiting symptoms of PTSD (101). Intrusive rumination—repetitive, uncontrollable dwelling on negative thoughts or past events—can act as a severe, overlapping catalyst across PTSD, depression, and generalized anxiety disorder.

Limitations

This study has several limitations that ought to be considered when analyzing the results. Firstly, measures of potentially traumatic events, PTSD, anxiety, depression, loneliness, and life satisfaction were only assessed through self-reporting. Self-reporting measures may introduce response bias or social desirability bias and may not capture the full extent of symptoms. Therefore, the results cannot replace direct assessments by mental health professionals, and caution is warranted when interpreting them. Secondly, the study's cross-sectional design does not allow us to determine the direction of the relationships or the causal effects of the variables on one another. Consequently, we can't conclude how psychiatric symptoms develop and how they progress over time during the acute phase following an earthquake or within the first year. Therefore, future studies should use longitudinal designs to establish temporal relationships among variables and examine causal relationships.

The third limitation of our study is the gender differences between the samples of Turkish local youth and Syrian migrant youth. Although we adjusted each symptom node for participant gender within each group, and gender did not explain the cross-cultural differences, it would be helpful to examine our results while accounting for gender differences across the samples we surveyed.

Finally, the stronger association between trauma and PTSD observed among Turkish youth in our study can be explained by the fact that a relatively larger proportion of Turkish youth in our sample—whose homes were destroyed or severely damaged—were still forced to live in containers at the time of the study (approximately 1.5 to 2 years after the disaster), compared to Syrian youth. However, young people living in container cities, who are more likely to have experienced traumatic events such as being injured during the earthquake, being trapped in earthquake rubble, or witnessing the loss of loved ones, constitute only a relatively small portion of both samples. According to TÜİK (Turkey’s official statistics agency) (42) data, the proportion of Turks adversely affected by the earthquake within Turkey’s borders

and the Turkish population in the region appear to be higher than that of Syrian refugees. However, based on the available data, it is not possible to make definitive estimates of the severity of the earthquake's impact on either cultural population. Consequently, our study may exhibit bias in this context and may not accurately reflect the true differences between the relevant populations. It would be helpful to examine our study's results while taking these potential biases into account.

Conclusion

In conclusion, our network analysis study—conducted with a community sample of 3,071 adolescents and emerging adults in the earthquake-affected region, which was significantly impacted by the Kahramanmaraş earthquake, approximately 1.5 to 2 years after the disaster—reveals that the clusters of post-traumatic internalization symptoms differ between local Turkish youth and Syrian migrant youth. The Turkish youth sample showed a strong association between trauma and PTSD symptoms, with mood symptoms such as loneliness, depression, or affective PTSD symptoms being more prominent bridges. In the Syrian migrant youth sample, a strong association was observed between trauma and symptoms of social anxiety, with the prominent bridge role of depression and anxiety symptom clusters like hyperarousal, social anxiety, and panic/somatic.

Among local Turkish youth, loneliness emerged as the strongest bridge node within the psychopathological network, followed by depression or PTSD-related mood symptoms. Loneliness was strongly linked to depression and appeared to connect traumatic experiences with mood symptoms. Loneliness also facilitates comorbidities, with bridging depression and anxiety symptoms like separation anxiety and generalized anxiety. At the same time, depression showed a close relationship with social anxiety among Turkish youths.

Depression served as the most prominent bridge node in the Syrian migrant sample, showing strong links with intrusion symptoms and anxiety-related manifestations such as school avoidance. Hyperarousal was the second prominent bridge node among Syrian migrant youth. Hyperarousal and avoidance symptoms were associated with diminished well-being, indicating that trauma-related processes may impair daily functioning and contribute to mood symptoms. Hyperarousal is also connected to mood symptoms such as lower life satisfaction and well-being, and panic/somatic symptoms, suggesting that cumulative trauma-related chronic physiological arousal may facilitate the development of broader anxiety symptoms (2, 7). The findings of our study suggest that psychopathological patterns among young Syrian refugees exhibit a more complex and transdiagnostic structure, reflecting the effects of cumulative traumatic experiences resulting from successive, cumulative life events such as war, migration, post-migration stressors, and earthquakes.

Declarations

Conflict of interest

The authors declare no competing interests.

Ethics approval

This study was conducted in accordance with the permission obtained from the ethics committee of a Toros University (2024/127).

Consent to participate

The study procedures adhered to the Declaration of Helsinki. All participants completed an informed voluntary consent form, and parental consent was obtained for participants under 18 years of age. Subjects participated voluntarily and were free to withdraw at any time.

Funding

The authors did not receive support from any organization for the submitted manuscript.

Author Contribution

All authors were responsible for the study concept and design. OY, RÇ and İSA undertook the data management. OY and RÇ undertook the statistical analyses. All authors interpreted the results. OY, AE, RÇ, GFÇ drafted the initial manuscript. LT critically reviewed the manuscript. All authors approved the submitted version.

Acknowledgement

We would like to express our sincere appreciation to all the participants who generously shared their time and provided valuable insights for this study. We also extend our gratitude to the staff of the Freedom Schooner Association and Turkish Psychological Association for their support in facilitating the data collection process.

Data Availability

The datasets used during the current study are available from the corresponding author on reasonable request.

References

1. Kandemir H, Karataş H, Çeri V, Solmaz F, Kandemir SB, Solmaz A (2018) Prevalence of war-related adverse events, depression and anxiety among Syrian refugee children settled in Turkey. Eur Child Adolesc Psychiatry 27(11):1513–1517. https://doi.org/10.1007/s00787-018-1178-0

2. Hinchey LME, Nashef R, Bazzi C, Gorski K, Javanbakht A (2023) The longitudinal impact of war exposure on psychopathology in Syrian and Iraqi refugee youth. Int J Soc Psychiatry 69(7):1833–1836. https://doi.org/10.1177/00207640231177829
3. Eruyar S, Maltby J, Vostanis P (2018) Mental health problems of Syrian refugee children: the role of parental factors. Eur Child Adolesc Psychiatry 27(4):401–409. https://doi.org/10.1007/s00787-017-1101-0
4. Özaslan A, Yildirim M, Guney E, İlhan MN, Vostanis P (2024) Mental health problems and help-seeking behaviours of Syrian refugee adolescents: Mediating role of self-stigma. Psychol Med 54(4):732–741. https://doi.org/10.1017/s0033291723002416
5. Gormez V, Kılıç HN, Orengul AC, Demir MN, Mert EB, Makhlouta B, Kınık K, Semerci B (2018) Evaluation of a school-based, teacher-delivered psychological intervention group program for trauma-affected Syrian refugee children in Istanbul, Turkey. Psychiatry Clin Psychopharmacol 27(2):125–131. https://doi.org/10.1080/24750573.2017.1304748
6. Sapmaz SY, Tanrıverdi BU, Öztürk M, Gözaçanlar Ö, Ülker GY, Özkan Y (2017) Immigration-related mental health disorders in refugees 5–18 years old living in Turkey. Neuropsychiatr Dis Treat 13(2017):2813–2821. 10.2147/ndt.s150592
7. Hinchey LME, Chammaa M, Ruvolo Grasser L, Saad B, Gorski K, Javanbakht A (2025) What happened matters: Trauma type and cumulative trauma exposure in refugee youth psychopathology. Psychol Trauma 17(4):705–712. https://doi.org/10.1037/tra0001618
8. Javanbakht A, Stenson A, Nugent N, Smith A, Rosenberg D, Jovanovic T (2021) Biological and environmental factors affecting risk and resilience among Syrian refugee children. J Psychiatry Brain Sci 6(1):e210003. https://doi.org/10.20900/jpbs.20210003
9. Yılmaz E, Tamam L, Cengisiz C (2024) Post-traumatic stress disorder among long-term resettled Syrian refugees in Turkey: a comprehensive analysis of pre- and post-migratory factors. Front Psychiatry 15(1):1352288. https://doi.org/10.3389/fpsyt.2024.1352288
10. Drescher A, Kiselev N, Akhtar A, Acarturk C, Bryant RA, Ilkkursun Z, von Känel R, Miller KE, Pfaltz MC, Schick M, Schnyder U, Sijbrandij M, Spaaij J, Morina N (2021) Problems after flight: understanding and comparing Syrians' perspectives in the Middle East and Europe. BMC Public Health 21(1):717. https://doi.org/10.1186/s12889-021-10498-1
11. Rahim HF, Mooren TT, Knipscheer JW, Chung JM, Laceulle OM, Boelen PA (2025) Temporal associations between cultural identity conflict and psychological symptoms among Syrian young adults with refugee backgrounds: a four-wave longitudinal study. Eur J Psychotraumatol 16(1):2511524. https://doi.org/10.1080/20008066.2025.2511524
12. Eruyar S, Maltby J, Vostanis P (2020) How do Syrian refugee children in Turkey perceive relational factors in the context of their mental health? Clin Child Psychol Psychiatry 25(1):260–272. https://doi.org/10.1177/1359104519882758
13. Kaloti R, Diab JL, Alkhalil M, Rayes D, Abbara A (2024) Compounding challenges for Syrian refugees in Türkiye in the wake of the earthquake. Lancet Glob Health 12(4):e557–e558.

https://doi.org/10.1016/s2214-109x(24)00044-5

14. Düken ME, Kaplan V, Almazan J (2024) The association between posttraumatic stress disorder and mental health of adolescents who exposed to the worst disaster of the century: Extensive data from southeast Turkey. J Child Adolesc Psychiatr Nurs 37(1):e12449. https://doi.org/10.1111/jcap.12449
15. Efendi GY, Temeltürk RD, Çakmak IB, Dinçer M (2023) Surviving the immediate aftermath of a disaster: A preliminary investigation of adolescents' acute stress reactions and mental health needs after the 2023 Turkey earthquakes. Child (Basel) 10(9):1485. https://doi.org/10.3390/children10091485
16. Kaplan V, Düken ME, Kaya R, Alkasaby M (2024) The impact of Kahramanmaraş (2023) earthquake on adolescents: Exploring psychological impact, suicide possibility and future expectations. Glob Ment Health (Camb) 11(1):e115. https://doi.org/10.1017/gmh.2024.90
17. Özdemir F, Sinanoğlu B, Demir A, Şen ME, Ucuz I, Kızılay F, İnceoğlu F, Kızılay E (2026) Investigation of the relationship between physical activity levels and mental health in adolescents after February 6th earthquakes. Sci Rep 16(1):8861. https://doi.org/10.1038/s41598-026-40645-w
18. Yakşi N, Eroğlu M (2024) Determinants of posttraumatic stress disorder among children and adolescents in the subacute stage of the Kahramanmaraş earthquake. Arch Public Health 82(1):199. https://doi.org/10.1186/s13690-024-01434-x
19. Ataya J, Soqia J, Ataya J, AlMhasneh R, Batesh D, Alkhadraa D, Albokaai H, Morjan M (2024) Sleep quality and mental health differences following Syria-Turkey earthquakes: A cross-sectional study. Int J Soc Psychiatry 70(4):700–708. https://doi.org/10.1177/00207640231223432
20. Ünver H, Fiş NP (2025) Mental health problems and risk factors of refugee children exposed to the 2023 earthquakes in Turkey. Arch Psychiatr Nurs 54(1):39–45. https://doi.org/10.1016/j.apnu.2025.01.001
21. Gunes S, Kalinli EM, Varmis DA, Kamis B, Kocak E, Sefik P, Erol Tanrikulu E, Ozluk HK, Baysal A, Ulutas GI (2025) Dual psychological pathways after earthquake trauma: posttraumatic growth and PTSD predict Health-Related quality of life in youth. BMC Psychol 13(1):1047. https://doi.org/10.1186/s40359-025-03411-7
22. Yektaş Ç, Erman H, Tufan AE (2021) Traumatic experiences of conditional refugee children and adolescents and predictors of post-traumatic stress disorder: data from Turkey. Nord J Psychiatry 75(6):420–426. https://doi.org/10.1080/08039488.2021.1880634
23. Gormez V, Kılıç HN, Orengul AC, Demir MN, Demirlikan Ş, Demirbaş S, Babacan B, Kınık K, Semerci B (2018) Psychopathology and associated risk factors among forcibly displaced Syrian children and adolescents. J Immigr Minor Health 20(3):529–535. https://doi.org/10.1007/s10903-017-0680-7
24. Hinchey LME (2024) Progressive worsening of posttraumatic stress symptoms in Syrian and Iraqi refugees associated with cumulative and victimization trauma: A longitudinal study. Psychol Trauma 16(5):793–801. https://doi.org/10.1037/tra0001698
25. Veronese G, Pepe A, Giordano F (2021) Child psychological adjustment to war and displacement: A discriminant analysis of resilience and trauma in Syrian refugee children. J Child Fam Stud

30(10):2575–2588. https://doi.org/10.1007/s10826-021-02067-2

26. White J, Manderson L, Newman L, Melvin G (2021) Understandings of trauma: contrasting Sudanese refugees and Holocaust survivors. J Refugee Stud 34(2):2238–2251. https://doi.org/10.1093/jrs/feaa019
27. Choe R, Lardier DT, Hess JM, Blackwell MA, Amer S, Ndayisenga M, Deewa S, Isakson B, Goodkind JR (2024) Measuring culturally and contextually specific distress among Afghan, Iraqi, and Great Lakes African refugees. Am J Orthopsychiatry 94(3):246–261. https://doi.org/10.1037/ort0000718
28. Moses S, Holmes D (2022) What mental illness means in different cultures: perceptions of mental health among refugees from various countries of origin. MHGCJ 5(2):6–16. https://doi.org/10.56508/mhgcj.v5i2.126
29. Hinton DE, Rivera EI, Hofmann SG, Barlow DH, Otto MW (2012) Adapting CBT for traumatized refugees and ethnic minority patients: Examples from culturally adapted CBT (CA-CBT). Transcult Psychiatry 49(2):340–365. https://doi.org/10.1177/1363461512441595
30. Eskici HS, Hinton DE, Jalal B, Yurtbakan T, Acarturk C (2023) Culturally adapted cognitive behavioral therapy for Syrian refugee women in Turkey: A randomized controlled trial. Psychol Trauma 15(2):189–198. https://doi.org/10.1037/tra0001138
31. Akgül S, Hüsnü Ş, Derman O, Özmert E, Bideci A, Hasanoğlu E (2019) Mental health of Syrian refugee adolescents: how far have we come? Turk J Pediatr 61(6):839–845. https://doi.org/10.24953/turkjped.2019.06.003
32. Galatzer-Levy IR, Bryant RA (2013) 636,120 ways to have posttraumatic stress disorder. Perspect Psychol Sci 8(6):651–662. https://doi.org/10.1177/1745691613504115
33. Fried EI, Nesse RM (2015) Depression is not a consistent syndrome: An investigation of unique symptom patterns in the STAR*D study. J Affect Disord 172(1):96–102. https://doi.org/10.1016/j.jad.2014.10.010
34. Borsboom D, Cramer AOJ (2013) Network Analysis: an integrative approach to the structure of psychopathology. Annu Rev Clin Psychol 9(1):91–121. https://doi.org/10.1146/annurev-clinpsy-050212-185608
35. Borsboom D (2017) A network theory of mental disorders. World Psychiatry 16(1):5–13. https://doi.org/10.1002/wps.20375
36. McNally RJ (2016) Can network analysis transform psychopathology? Behav Res Ther 86(1):95–104. https://doi.org/10.1016/j.brat.2016.06.006
37. Fried EI, Eidhof MB, Palic S, Costantini G, Huisman-van Dijk HM, Bockting CL, Engelhard I, Armour C, Nielsen ABS, Karstoft KI (2018) Replicability and generalizability of posttraumatic stress disorder (PTSD) networks: A cross-cultural multisite study of PTSD symptoms in four trauma patient samples. Clin Psychol Sci 6(3):335–351. https://doi.org/10.1177/2167702617745092
38. Birkeland MS, Greene T, Spiller TR (2020) The network approach to posttraumatic stress disorder: A systematic review. Eur J Psychotraumatol 11(1):1700614. https://doi.org/10.1080/20008198.2019.1700614

39. McNally RJ, Robinaugh DJ, Wu GW, Wang L, Deserno MK, Borsboom D (2015) Mental disorders as causal systems: A network approach to posttraumatic stress disorder. Clin Psychol Sci 3(6):836–849. https://doi.org/10.1177/2167702614553230
40. Kazlauskas E, Jovarauskaite L, Abe K, Brewin CR, Cloitre M, Daniunaite I, Haramaki Y, Hihara S, Kairyte A, Kamite Y, Sugimura K, Thoresen S, Zelviene P, Truskauskaite-Kuneviciene I (2022) Trauma exposure and factors associated with ICD-11 PTSD and complex PTSD in adolescence: A cross-cultural study in Japan and Lithuania. Epidemiol Psychiatr Sci 31(1):e49. https://doi.org/10.1017/s2045796022000336
41. Karaman MA, Ricard RJ (2016) Meeting the mental health needs of Syrian refugees in Turkey. TPC 6(4):318–327. https://doi.org/10.15241/mk.6.4.318
42. The Results of Address Based Population Registration System (2024) Turkish Statistical Institute, Available online at: https://veriportali.tuik.gov.tr/en/press/53783 ; Accessed July 12, 2025
43. Utucu SB (2025) 6 Şubat depremlerinin üzerinden 2 yıl geçti: 650.000 kişi hâlâ konteynerde yaşıyor. Euronews Türkçe, Available online at: https://tr.euronews.com/2025/02/05/6-subat-depremlerinin-uzerinden-2-yil-gecti-650000-kisi-hala-konteynerde-yasiyor ; Accessed July 10, 2025
44. Children and War Foundation (2005) Children's Revised Impact of Event Scale (CRIES-13)
45. Çeri V, Hamidi F, Çakır B, Bilaç Ö, İz M, Ay İz FB, Aydemir Ö (2021) Child revised impact of event scale (CRIES): Validity and reliability study of Turkish version. Neuropsychiatr Invest 59(1):21–26. https://doi.org/10.5455/NYS.20201101115427
46. Veronese G, Pepe A (2022) Measuring traumatic reactions in palestinian children: a psychometric assessment of the children revised impact of event scale-arabic version (CRIES-13A). Child Psychiatry Hum Dev 53(1):16–26. https://doi.org/10.1007/s10578-020-01113-2
47. Chaaya R, Obeid S, Postigo A, Dagher D, Hallit R, Malaeb D, Dabbous M, Sakr F, Fekih-Romdhane F, Hallit S (2023) Validation of the Arabic version of the resilience scale for adolescents (READ). BMC Psychiatry 23(1):713. https://doi.org/10.1186/s12888-023-05219-4
48. Neto F (2006) Dimensions and correlates of social axioms among a Portuguese sample. Indiv Differ Res 4(5):340–351. https://doi.org/10.65030/idr.04031
49. Alateeq D, Aljabri A, Aldogiam G, Alajmi H, Alsoqaih H, Alfadhly R, Alshahrani R (2022) Psychometric properties of the Arabic version of the UCLA Loneliness Scale among Saudi female undergraduate students. IJMDC 6(1):149–154. https://doi.org/10.24911/IJMDC.51-1638046495
50. Sarıçam H (2023) COVID-19 Sonrası Yetişkinlerde Yalnızlık: UCLA Yalnızlık Ölçeği Kısa Formunun (UYÖKF-6) Psikometrik Özellikleri. SOSBİLDER 32(1):1–17. https://doi.org/10.54600/igdirsosbilder.1066242
51. Birmaher B, Brent DA, Chiappetta L, Bridge J, Monga S, Baugher M (1999) Psychometric properties of the screen for child anxiety related emotional disorders (SCARED): a replication study. J Am Acad Child Adolesc Psychiatry 38(10):1230–1236. https://doi.org/10.1097/00004583-199910000-00011
52. Hariz N, Bawab S, Atwi M, Tavitian L, Zeinoun P, Khani M, Birmaher B, Nahas Z, Maalouf FT (2013) Reliability and validity of the Arabic screen for child anxiety related emotional disorders (SCARED) in

a clinical sample. Psychiatry Res 209(2):222–228. https://doi.org/10.1016/j.psychres.2012.12.002

53. Cakmakci FK (2004) Validity and reliability study of the screening for anxiety disorders in children [unpublished specialty thesis, Kocaeli University Faculty of Medicine]
54. Diener E, Emmons RA, Larsen RJ, Griffin S (1985) The satisfaction with life scale. J Pers Assess 49(1):71–75. https://doi.org/10.1207/s15327752jpa4901_13
55. Köker S (1991) Normal ve sorunlu ergenlerin yaşam doyumu düzeyinin karşılaştırılması [Master's thesis, Ankara University/School of Social Sciences]
56. Abdallah T (1998) The satisfaction with life scale (SWLS): psychometric properties in an Arabic-speaking sample. Int J Adolesc Youth 7(2):113–119. https://doi.org/10.1080/02673843.1998.9747816
57. Brooks SJ, Krulewicz SP, Kutcher S (2003) The Kutcher Adolescent Depression Scale: Assessment of its evaluative properties over the course of an 8-week pediatric pharmacotherapy trial. J Child Adolesc Psychopharmacol 13(3):337–349. https://doi.org/10.1089/104454603322572679
58. Ammar MAA (2022) Social Networks Addiction in relation with suggestability and depression of adolescents: psychometric—clinical study [unpublished specialty thesis, South Valley University Faculty of Education]
59. Tatar A, Bekiroğlu ATB (2024) Kutcher Ergen Depresyon Ölçeği Kısa Formunun (KEDÖ-6-TR) Türkçe'ye çevrilmesi ve psikometrik özelliklerinin incelenmesi. Soc Ment Res Think J 5(22):1200–1209. https://doi.org/10.31576/smryj.331
60. Epskamp S, Borsboom D, Fried EI (2018) Estimating psychological networks and their accuracy: A tutorial paper. Behav Res Methods 50(1):195–212. https://doi.org/10.3758/s13428-017-0862-1
61. Haslbeck JMB, Waldorp LJ (2018) How well do network models predict observations? On the importance of predictability in network models. Behav Res Methods 50(2):853–861. https://doi.org/10.3758/s13428-017-0910-x
62. Epskamp S, Cramer AOJ, Waldorp LJ, Schmittmann VD, Borsboom D (2012) qgraph: Network visualizations of relationships in psychometric data. J Stat Softw 48(4):1–18. https://doi.org/10.18637/jss.v048.i04
63. Jones PJ, Ma R, McNally RJ (2021) Bridge centrality: a network approach to understanding comorbidity. Multivar Behav Res 56(2):353–367. https://doi.org/10.1080/00273171.2019.1614898
64. Bringmann LF, Elmer T, Epskamp S, Krause RW, Schoch D, Wichers M, Wigman JTW, Snippe E (2019) What do centrality measures measure in psychological networks? J Abnorm Psychol 128(8):892–903. https://doi.org/10.1037/abn0000446
65. van Borkulo CD, van Bork R, Boschloo L, Kossakowski JJ, Tio P, Schoevers RA, Borsboom D, Waldorp LJ (2023) Comparing network structures on three aspects: A permutation test. Psychol Methods 28(6):1273–1285. https://doi.org/10.1037/met0000476
66. Pfeiffer E, Sukale T, Müller LRF, Plener PL, Rosner R, Fegert JM, Sachser C, Unterhitzenberger J (2019) The symptom representation of posttraumatic stress disorder in a sample of

unaccompanied and accompanied refugee minors in Germany: a network analysis. Eur J Psychotraumatol 10(1):1675990. https://doi.org/10.1080/20008198.2019.1675990

67. Kangaslampi S, Garoff F, Peltonen K (2021) A network analysis of posttraumatic stress symptoms among help-seeking refugees in Kenya. J Anxiety Disord 82(1):102358. https://doi.org/10.1016/j.janxdis.2021.102358
68. Schumacher L, Burger J, Zoellner F, Zindler A, Epskamp S, Barthel D (2021) Using clinical expertise and empirical data in constructing networks of trauma symptoms in refugee youth. Eur J Psychotraumatol 12(1):1920200. https://doi.org/10.1080/20008198.2021.1920200
69. Bridges-Curry Z, Christian C, Levinson CA (2021) Network analysis of PTSD symptoms in a sample of polyvictimized youth. J Trauma Dissociation 23(4):401–415. https://doi.org/10.1080/15299732.2021.1989115
70. Martin CG, Cromer LD, DePrince AP, Freyd JJ (2013) The role of cumulative trauma, betrayal, and appraisals in understanding trauma symptomatology. Psychol Trauma 5(2):110–118. https://doi.org/10.1037/a0025686
71. Stefanovic M, Ehring T, Wittekind CE, Werner GG, Kunze AE (2022) Comparing PTSD symptom networks in type I vs. type II trauma survivors. Eur J Psychotraumatol 13(2):2114260. https://doi.org/10.1080/20008066.2022.2114260
72. Ferreira FT, Gysi DM, Castro D, Ferreira TB (2022) The nosographic structure of posttraumatic stress symptoms across trauma types: An exploratory network analysis approach. J Trauma Stress 35(3):915–926. https://doi.org/10.1002/jts.22818
73. Segal A, Wald I, Lubin G, Fruchter E, Ginat K (2020) Changes in the dynamic network structure of PTSD symptoms from pre- to post-combat. Psychol Med 50(6):956–964. https://doi.org/10.1017/S0033291719000539
74. Misitano A, Geddo F, Oppo A, Barbieri A, Righi E, Caffo E, Forresi B (2025) Network structure of post-traumatic stress and social/emotional/behavioral difficulties in a post-earthquake child and adolescent sample. Eur J Investig Health Psychol Educ 15(11):225. https://doi.org/10.3390/ejihpe15110225
75. Ge F, Yuan M, Li Y, Zhang J, Zhang W (2019) Changes in the network structure of posttraumatic stress disorder symptoms at different time points among youth survivors: A network analysis. J Affect Disord 259(1):288–295. https://doi.org/10.1016/j.jad.2019.08.065
76. Tovote P, Fadok JP, Lüthi A (2015) Neuronal circuits for fear and anxiety. Nat Rev Neurosci 16(6):317–331. https://doi.org/10.1038/nrn3945
77. Cao X, Wang L, Cao C, Fang R, Chen C, Hall BJ, Elhai JD (2019) Sex differences in global and local connectivity of adolescent posttraumatic stress disorder symptoms. J Child Psychol Psychiatry 60(2):216–224. https://doi.org/10.1111/jcpp.12963
78. An Y, Hu CP, Zhao J, Chen Y, Wu X (2021) Changes in the network structure of post-traumatic stress disorder symptoms among earthquake exposed adolescents in China: A 2-Year Longitudinal Study. Child Psychiatry Hum Dev 52(1):104–113. https://doi.org/10.1007/s10578-020-00995-6

79. An Y, Fu F, Wu X, Lin C, Zhang Y (2013) Longitudinal relationships between neuroticism, avoidant coping, and posttraumatic stress disorder symptoms in adolescents following the 2008 Wenchuan earthquake in China. J Loss Trauma 18(3):256–270. https://doi.org/10.1080/15325024.2012.719351
80. Pacella ML, Irish L, Ostrowski SA, Sledjeski E, Ciesla JA, Fallon W, Spoonster E, Delahanty DL (2011) Avoidant coping as a mediator between peritraumatic dissociation and posttraumatic stress disorder symptoms. J Trauma Stress 24(3):317–325. https://doi.org/10.1002/jts.20641
81. Kazlauskas E, Jovarauskaite L, Abe K, Brewin CR, Cloitre M, Daniunaite I, Haramaki Y, Hihara S, Kairyte A, Kamite Y, Sugimura K, Thoresen S, Zelviene P, Truskauskaite-Kuneviciene I (2022) Trauma exposure and factors associated with ICD-11 PTSD and complex PTSD in adolescence: a cross-cultural study in Japan and Lithuania. Epidemiol Psychiatr Sci 31(1):e49. https://doi.org/10.1017/S2045796022000336
82. Wu CH, Chen SH, Weng LJ, Wu YC (2009) Social relations and PTSD symptoms: a prospective study on earthquake-impacted adolescents in Taiwan. J Trauma Stress 22(5):451–459. https://doi.org/10.1002/jts.20447
83. Fan F, Long K, Zhou Y, Zheng Y, Liu X (2015) Longitudinal trajectories of post-traumatic stress disorder symptoms among adolescents after the Wenchuan earthquake in China. Psychol Med 45(13):2885–2896. https://doi.org/10.1017/S0033291715000884
84. Tanaka E, Iso H, Tsutsumi A, Kameoka S, You Y, Kato H (2019) School-based psychoeducation and storytelling: Associations with long-term mental health in adolescent survivors of the Wenchuan earthquake. Epidemiol Psychiatr Sci 29:e65. https://doi.org/10.1017/S2045796019000611
85. Xu B, Yuan H, Wu X, Wang W (2023) Comorbidity patterns of posttraumatic stress disorder and depression symptoms: cross-validation in two postearthquake child and adolescent samples. Depress Anxiety 2023(1):4453663. https://doi.org/10.1155/2023/4453663
86. Qi J, Ye Y, Sun R, Zhen R, Zhou X (2023) Comorbidity of posttraumatic stress disorder and depression among adolescents following an earthquake: a longitudinal study based on network analysis. J Affect Disord 324(1):354–363. https://doi.org/10.1016/j.jad.2022.12.119
87. World Health Organization (2018) International Classification of Diseases for Mortality and Morbidity Statistics. 11th Revision. Lyon
88. American Psychiatric Association (2013) Diagnostic and Statistical Manual of Mental Disorders. 5th ed. Arlington, VA
89. Zhou X, Wu X (2019) Temporal transitions in patterns of posttraumatic stress disorder and depression among adolescents following the Wenchuan earthquake. Child Psychiatry Hum Dev 50(3):494–504. https://doi.org/10.1007/s10578-018-0859-8
90. Grasser LR, Jovanovic T (2021) Safety learning during development: Implications for development of psychopathology. Behav Brain Res 408(1):113297. https://doi.org/10.1016/j.bbr.2021.113297
91. Fazel M, Reed RV, Panter-Brick C, Stein A (2012) Mental health of displaced and refugee children resettled in high-income countries: risk and protective factors. Lancet 379(9812):266–282.

https://doi.org/10.1016/S0140-6736(11)60051-2

92. Jarlby F, Goosen S, Derluyn I, Vitus K, Jervelund SS (2018) What can we learn from unaccompanied refugee adolescents' perspectives on mental health care in exile? Eur J Pediatr 177(12):1767–1774. https://doi.org/10.1007/s00431-018-3249-0
93. Oberg C, Sharma H (2023) Post-traumatic stress disorder in unaccompanied refugee minors: prevalence, contributing and protective factors, and effective interventions: A Scoping Review. Child (Basel) 10(6):941. https://doi.org/10.3390/children10060941
94. Ross J, Armour C, Kerig PK, Kidwell MC, Kilshaw RE (2020) A network analysis of posttraumatic stress disorder and dissociation in trauma-exposed adolescents. J Anxiety Disord 72(1):102222. https://doi.org/10.1016/j.janxdis.2020.102222
95. Kratzer L, Knefel M, Haselgruber A, Heinz P, Schennach R, Karatzias T (2022) Co-occurrence of severe PTSD, somatic symptoms and dissociation in a large sample of childhood trauma inpatients: a network analysis. Eur Arch Psychiatry Clin Neurosci 272(5):897–908. https://doi.org/10.1007/s00406-021-01342-z
96. Blackmore R, Gray KM, Boyle JA, Fazel M, Ranasinha S, Fitzgerald G, Misso M, Gibson-Helm M (2020) Systematic Review and Meta-analysis: The prevalence of mental illness in child and adolescent refugees and asylum seekers. J Am Acad Child Adolesc Psychiatry 59(6):705–714. https://doi.org/10.1016/j.jaac.2019.11.011
97. Behrendt M, Vervliet M, Rota M, Adeyinka S, Uzureau O, Rasmussen A, Glaesmer H, Lietaert I, Derluyn I (2023) A conceptual study on the relationship between daily stressors, stressful life events, and mental health in refugees using network analysis. Front Psychol 14(1):1134667. https://doi.org/10.3389/fpsyg.2023.1134667
98. Solhaug AK, Oppedal B, Røysamb E, Calam R (2024) Life Satisfaction among Unaccompanied Refugee Minors: Associations with Traumatic Events and Daily Hassles. J Child Adolesc Trauma 17(2):597–610. https://doi.org/10.1007/s40653-023-00579-1
99. Oppedal B, Keles S, Røysamb E (2022) Subjective well-being among unaccompanied refugee youth: Longitudinal associations with discrimination and ethnic identity crisis. Front Psychol 13(1):920657. https://doi.org/10.3389/fpsyg.2022.920657
100. Li H, Liu J, Wang Y, Li Z, Mei S, Zhang Z, Fan L, Jiang L (2025) Longitudinal network analysis of depression, anxiety, and post-traumatic stress disorder comorbidities among adolescents in regional China. Front Public Health 13(1):1522877. https://doi.org/10.3389/fpubh.2025.1522877
101. Zhabenko O, Ben-Zion Z, Raffelhüschen P, Burrer A, Seifritz E, Just S, Preller KH, Duek O, Paterson M, Pietrzak RH, Joormann J, Spiller TR, Harpaz-Rotem I (2026) Relationship between rumination and symptoms of posttraumatic stress disorder - a cross-sectional network analysis. Front Psychiatry 17(1):1786768. https://doi.org/10.3389/fpsyt.2026.1786768

Figures

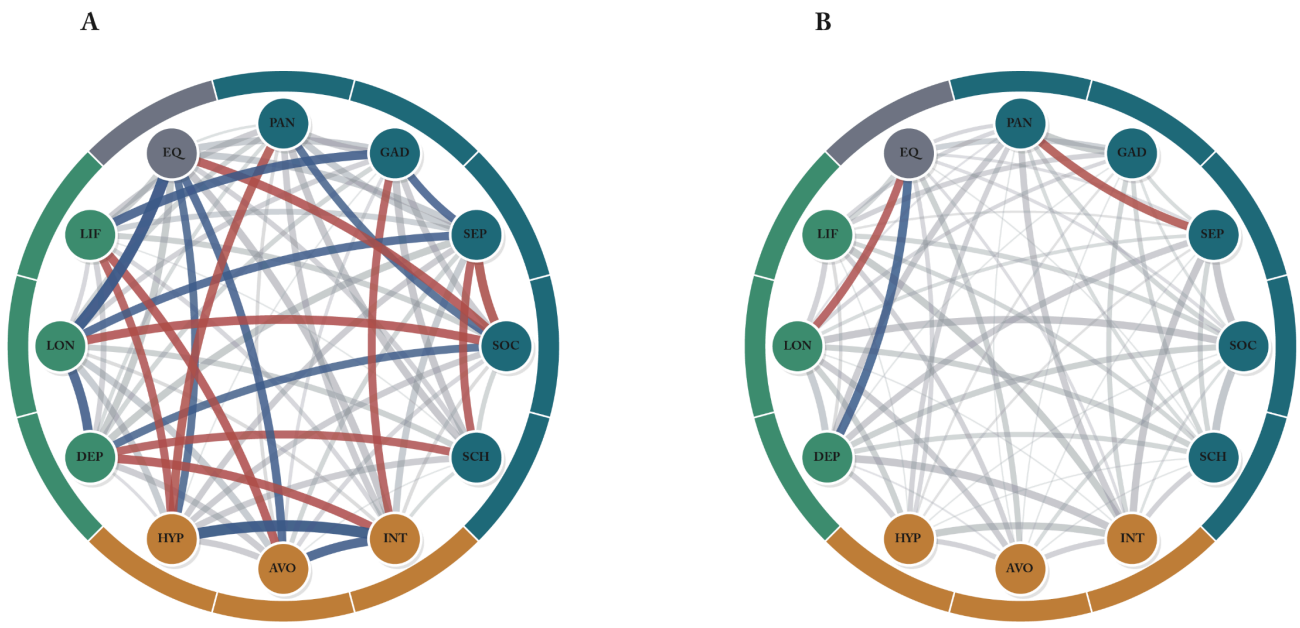


Figure 1

Difference networks comparing symptom-network structure between groups. (A) Turkish vs. Syrian adolescents (nodes residualized on war exposure and gender); (B) the two gender groups (residualized on war exposure and culture). Node/ring colour = symptom domain (teal = anxiety, orange = post-traumatic stress, green = mood/well-being, grey = earthquake exposure). Each line is the between-group difference in regularized partial correlation (EBICglasso, γ = .50) for that node pair; width and opacity scale with the difference. Coloured lines are significant after family-wise correction ($p < 0.05$): blue = stronger in the first group (Turkish/gender 1), red = stronger in the second (Syrian/gender 2); grey lines are non-significant. PAN = panic/somatic, GAD = generalized anxiety, SEP = separation anxiety, SOC = social phobia, SCH = school avoidance, INT = intrusion, AVO = avoidance, HYP = hyperarousal, DEP = depression, LON = loneliness, LIF = life satisfaction, EQ = earthquake exposure.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- Tables.pdf
- SupplementaryMaterials.pdf
- SupplementaryMaterials.docx