Words: 3500

Tables: 2

Figures: 2

**Positive symptoms of psychosis and ICD-11 complex post-traumatic stress disorder: A network analysis in a Canadian sample from Montreal**

Running head: ICD-11 CPTSD and positive symptoms of psychosis

**Yafit Levin, PhD 1**

School of Social Work, Ariel University, Ariel, Israel

Department of Education, Ariel University, Ariel, Israel

yafitl@ariel.ac.il

**Amelie Mazza**

Department of Psychology, University of Zurich, Switzerland

amelie.mazza98@gmail.com

**Philip Hyland, PhD**

Department of Psychology, Maynooth University, Kildare, Ireland

Philip.hyland@mu.ie

**Thanos Karatzias, PhD**

Edinburgh Napier University, Edinburgh, Scotland, UK

NHS Lothian, Rivers Centre for Traumatic Stress, Edinburgh, Scotland, UK

t.karatzias@napier.ac.uk

**Mark Shevlin, PhD**

Psychology Research Institute, School of Psychology, Ulster University, Derry, Northern Ireland

m.shevlin@ulster.ac.uk

**Grainne McGinty**

Department of Psychology, Maynooth University, Kildare, Ireland

Grainne.mcginty.2020@mumail.ie

**Yaakov Hoffman, PhD**

Department of Social & Health Sciences, Bar-Ilan University, Ramat-Gan, Israel

hoffmay@gmail.com

**Eric Lis, MD**

Department of Psychiatry, McGill University, Montreal, Canada

eric.lis@mail.mcgill.ca

**Menachem Ben-Ezra, PhD**

School of Social Work, Ariel University, Ariel, Israel

menbe@ariel.ac.il

**Bachem Rahel, PhD**

Department of Psychology, University of Zurich, Switzerland

r.bachem@psychologie.uzh.ch

**1 Corresponding author:**

**Email:** **yafitl@ariel.ac.il** **Tel: 972-547957276, School of Social Work, Ariel University, Kiryat Hamda 9, Ariel, Israel.**

# **Abstract**

**Objectives**: Traumatic experiences constitute a risk factor for developing different psychopathologies, such as post-traumatic stress disorder (PTSD), complex post-traumatic stress disorder (CPTSD), and positive symptoms of psychosis. However, on the symptom level, it is still unclear how CPTSD and positive symptoms of psychosis associate with each other. The present study aimed to shed light on these dynamics by investigating the symptoms network of CPTSD and positive symptoms of psychosis.

**Methods**: A network analysis was performed on CPTSD and psychosis symptoms among a Canadian community sample with a history of traumatic life events (*n* = 747). Measures included the International Trauma Questionnaire (ITQ) and the mPRIME screen.

**Results**: 4.8% of the sample reached the criteria of probable PTSD; 7% fulfilled the criteria of probable CPTSD. PTSD and CPTSD groups had a significantly higher severity of positive symptoms of psychosis compared to the no-disorder group. Network analysis revealed three distinct communities of symptoms of PTSD, disturbances in self-organization, and psychosis. Affective dysregulation served as the bridging symptom between the communities. Hearing one’s own thoughts aloud was the most central symptom in the network.

**Conclusions**: Findings show that positive symptoms of psychosis can be considered trauma-related responses. Further, interventions targeting affective dysregulation as well as the experience and distress associated with hearing one’s own thoughts aloud may contribute to symptom reduction and improved functioning.

**Keywords:**

Complex post-traumatic stress disorder (CPTSD); post-traumatic stress disorder (PTSD); positive symptoms of psychosis; Symptoms network analysis

# **The association of positive symptoms of psychosis with complex post-traumatic stress disorder: A network analytical perspective**

A solid body of research shows that traumatic experiences are not only associated with a heightened risk for post-traumatic stress disorder (PTSD) but also constitute a risk factor for experiencing psychosis symptoms 1. The relationship between PTSD symptoms and psychosis symptoms has long been subject to research 2, and scholars proposed that PTSD and psychosis could be part of a spectrum of reactions to trauma 3,4. This perspective aligns with studies showing that DSM PTSD is a key predictor of psychotic symptom severity and is more prevalent among individuals with a psychotic disorder compared to the general population 5. However, scarce research has examined the association between ICD-11 PTSD and complex PTSD (CPTSD) with psychotic symptoms 6. Specifically, it remains unclear how symptoms of PTSD, CPTSD and psychosis interact with each other. The present study aimed to investigate the symptoms network of CPTSD and positive psychosis symptoms.

The diagnosis of CPTSD has been introduced in the 11th revision of the International Classification of Diseases 7. CPTSD includes both “classic” PTSD symptoms (re-experiencing the trauma, avoidance of traumatic reminders, and a persistent sense of threat) as well as disturbances in self-organization (DSO), and thus, represents more severe trauma sequelae 8. DSO comprises the three symptom clusters of affective dysregulation, negative self-concept, and difficulties in relationships 7. Evidence suggests that post-traumatic stress reactions occur on a continuum, whereby cumulative trauma exposure seemed to be conducive to a higher risk of developing more severe trauma sequelae, i.e. CPTSD 9. Furthermore, CPTSD often results from complex and chronic interpersonal traumatic experiences from which escape is difficult, such as childhood sexual or physical abuse 7. Childhood trauma, however, has also been recognized as an important risk factor for psychosis symptoms e.g., 1.

Positive psychosis symptoms comprise delusions, hallucinations, and formal thought disorder. Contrary to traditional beliefs that symptoms such as delusions and hallucinations are outside of the realm of normal experience, psychosis symptoms have recently become understood as a construct on a spectrum of severity 7. Psychotic-like experiences (i.e., psychosis symptoms that are not deemed clinically relevant) are found in general population samples with prevalence rates of up to 7·2% 10. Similarly to CPTSD, the risk of developing psychosis symptoms was shown to be linked to traumatic experiences in a dose-response manner in the general population 11.

However, few published studies explored the associations between psychosis symptoms and ICD-11 PTSD and CPTSD. Frost et al. 3 showed that cumulative childhood adversity was predictive of the occurrence (and co-occurrence) of both psychosis and CPTSD symptoms among a trauma-exposed population sample. Ho et al. 4 further confirmed the significance of this comorbidity, showing a moderate correlation between CPTSD and psychosis symptoms. Likewise, in an adolescent population study, both PTSD and CPTSD correlated with psychotic-like experiences, with CPTSD notably linked to greater distress related to psychosis symptoms 12. The authors suggested that CPTSD poses a higher risk for transitioning to psychosis than PTSD. Consistent with this, CPTSD prevalence exceeded that of PTSD in a trauma-exposed clinical sample with schizophrenia. Additionally, PTSD and DSO symptoms mediated the link between trauma exposure and positive psychosis symptoms 13. Finally, Mason et al. 6 showed that CPTSD (but not PTSD) was a significant mediator between childhood trauma and psychosis symptom severity. However, the subtle interactions among PTSD, CPTSD and psychosis symptoms remain less explored. Moreover, the question arises as to whether varying levels of trauma exposure are associated with the co-occurrence of PTSD, DSO, and psychosis-like symptoms. Network analysis, capable of uncovering these connections, remains underutilized in this context.Top of Form

Symptoms network analysis transcends traditional diagnostic categories
visually, representing the intricate relationships between symptoms and emphasizing key central and bridging symptoms essential for comprehending disorders 14. Central symptoms, with strong associations to others, represent pivotal aspects of the disorder and key treatment targets 15. Moreover, bridging symptoms link comorbidities and enable targeted interventions for co-occurring disorders 16. Despite its potential, network analysis has seldom been used to understand post-traumatic and psychosis symptoms. A notable study applied it to DSM-5 PTSD, revealing trauma-related negative self- and world views, self-blame and hypervigilance as key links between PTSD and psychosis symptoms 17. However, previous network analyses have used small samples of patients diagnosed with psychotic disorders 17 rather than large general population samples with subthreshold symptoms. Investigating the symptom network in large samples of the general population can enhance our understanding of early symptom interactions, aiding in the identification of public health warning signs. Moreover, exploring preclinical stages can reveal relevant information for the prevention of severe psychopathologies. Network analysis could identify key CPTSD symptoms linked to psychosis.

Top of Form

# The main goals of the present study were to: (1) investigate the relationships between CPTSD clusters, positive psychosis symptoms, and total trauma exposure; (2) examine the links between individual positive psychosis symptoms and the presence of PTSD/CPTSD vs. no disorder; (3) analyze symptom clusters (communities) in the network to assess if positive psychosis symptoms and PTSD/DSO manifest as distinct entities; (4) explore symptom strength centrality and bridges in the network to identify connections between positive psychosis and CPTSD; (5) determine if the association between CPTSD and positive psychosis symptoms in the network was moderated by trauma exposure level.Top of Form

#  Top of Form

# **Method**

**Participants**

The study utilized data from the Greater Montreal Area Study on mental health and creativity. Data were collected in July 2021 from 1,000 adults via Qualtrics using quota sampling based on sex, age, and geolocation. Participants, aged 18+, completed the study in English. Recruitment was through managed panels via email, SMS, or app notifications, with ethical approval from the first author’s University IRB (20191030). All participants provided electronic informed consent.

Top of Form

This study included 747 participants who experienced at least one traumatic life event and was approximately representative regarding sex, age, and geolocation 18, with 51·1% males and 48·9% females, aged 18 to 65 (M = 39.93 SD = 12.49). Among them, 60·1% were in committed relationships. Educational attainment varied, with 28·5% completing secondary school, 34·7% holding undergraduate degrees, and 35.3% holding postgraduate degrees. In terms of employment, 57·4% were employed full-time, 18·3% part-time, 8·0% unemployed and seeking work, and 16·2% not employed for various reasons.Top of Form

**Measures**

*Exposure to traumatic life events* was measured using the International Trauma Exposure Measure (ITEM). Consistent with the definition of trauma exposure in the ICD-11, the ITEM measures exposure to 21 different traumatic life events (total score ranging from 0 to 21(.

*PTSD and CPTSD* symptoms were measured using the International Trauma Questionnaire 19. The ITQ includes six PTSD items and six DSO items. The PTSD symptom clusters of re-experiencing (RE), avoidance (AV), and sense of threat (SoT) are measured using two items each. The DSO symptom clusters of aﬀective dysregulation (AD), negative self-concept (NSC), and disturbances in relationships (DiR) are measured by two items each. Functional impairment is assessed for both PTSD and DSO. All items were answered using a ﬁve-point adjectival scale ranging from ‘not at all’ (0) to ‘extremely’ (4). Scores ≥ 2 (‘moderately’) were used to indicate the presence of a symptom. Algorithms for probable PTSD and CPTSD endorsement can be found in Cloitre et al. (2018). The internal consistency estimates for the PTSD (α = .924) and DSO items (α = .917) in this study were excellent.

The mPRIME screen 20 is a short self-administered adaptation of the original PRIME screen questionnaire 21,22, assessing the risk for developing a psychotic disorder. It is based on the positive symptom items of the Structured Interview for Psychosis-Risk Syndromes 21. It asks about occurrence of positive symptoms over the last year with responses measured on a Likert-scale of 0 (‘definitely disagree’) to 6 (‘definitely agree’) with a response of ‘not sure’ being represented by a value of 3. Two of the original PRIME screen questionnaire were replaced (items 9 and 12) with modified items (See [Table 2](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4148134/figure/F1/) for full mPRIME screen and supplementary materials for further information). It showed a specificity and sensitivity (against SIPS as a gold standard) of 0.74 and 1.00, and a concordant validity 0f 0.43 22. The internal consistency in this study was excellent (α = .949).

**Statistical analysis**

We conducted a multivariate analysis of variance with Bonferroni post hoc tests and age and negative life events as covariates. CPTSD, PTSD and no-disorder group means were compared for individual items of positive psychosis symptoms.

**Network Estimation**

The symptom network was estimated for all symptoms of CPTSD (i.e. PTSD and DSO) and positive symptoms of psychosis using the R-package qgraph 23. The network was weighted and undirected as data were cross-sectional. Questionnaire data were answered at an ordinal scale, thus we estimated a polychoric matrix. We estimated partial pairwise correlation parameters between all nodes (i.e. symptoms), through a Gaussian Graphical Model 15. Regularized partial polychromic correlations were used as edge estimates, which represent the unique, independent relationships between symptoms. Edge estimates indicate how strongly two symptoms are related. This method directly estimates the inverse of the covariance matrix 24. In GGM, numerous parameters can create redundant edges, which are managed using the least absolute shrinkage and selection operator (LASSO) that utilizes partial correlations (implemented in qgraph; 25). Finally, we used the extended Bayesian Information Criterion 25 which estimates the inverse of the covariance matrixto choose the optimal model with a tuning parameter of 0.5.

**Network inference**

We used indices of centrality to describe the connectedness of each node in the network.

Central symptoms are highly connected to other symptoms and may act as "hubs" within the network. Addressing these symptoms in treatment may have widespread effects on the network. The centrality index node parameters were calculated using the *centrality Plot* and *centralityTable* functions in qgraph 23. The commonly used strength index of centrality for each network was calculated 26 .

**Stability and accuracy**

To assess the accuracy of the edge weight estimates, we conducted the bootnet package 15 using nonparametric bootstrapping based on 2000 samples, including estimating 95% confidence intervals around the edge weights. To assess the accuracy of the centrality estimates, we used the subsetting bootstrap function implemented in the bootnet package using 2000 samples (see supplementary materials for further information).

**Community detection**

The *spinglass* algorithm was used to identify communities of items in the network (i.e. symptom clusters that co-occur or reinforce one another) using the *igraph R*-package. Edges should connect nodes of the same community, whereas nodes belonging to different communities should not be connected 27. We ran the algorithm 1000 times with a different random seed for each run.

**Bridge symptoms**

We used the *bridge* function of the *networktools* package 28 to identify bridge symptoms between anxiety and depression in each network. This provides valuable insights, as it helps identify symptoms that increase the risk of comorbidity and should, therefore, be closely monitored in clinical practice. Bridge strength is defined as the sum of the absolute value of all edges that exist between a node and all nodes that are not in the same cluster.

**Group comparisons**

Additionally, we explored the moderating role of exposure level on the associations between CPTSD and psychosis-like symptoms in the network. Network invariance and global strength comparison tests were conducted between groups with high exposure (≥3 events, n = 705) vs. low exposure (1-2 events, n = 135) to traumatic life events. The Network Comparison Test (NCT) is described in supplementary materials.

# **Results**

Table 1 presents item level descriptive statistics for the ITQ and mPrime and correlation with total trauma exposure. Table 2 presents the overall frequency of the PTSD and DSO subfactors as well as means and standard deviations of the items of positive symptoms of psychosis across the groups of CPTSD, PTSD and no-disorder. A total of 4·8% (*n* = 40) of the sample reached the criteria of probable PTSD and an additional 7% (*n* = 48) fulfilled the criteria of probable CPTSD (88·2%; *n*=741 reported neither probable CPTSD nor PTSD).

**The association between specific positive psychosis symptoms and CPTSD /PTSD**

A multivariate analysis of variance, controlling for age and traumatic life events, found significant differences between CPTSD, PTSD, and no-disorder groups (all p-values < .0001). Table 2 shows specific comparisons, with uppercase letters denoting distinct or similar group means. Both CPTSD and PTSD groups reported higher psychosis risk symptoms than the no-disorder group, except for "special or supernatural gifts," where no difference was found between PTSD and no-disorder. However, the CPTSD group reported higher means for this symptom compared to both groups. The CPTSD group also showed a higher risk of psychosis symptoms than PTSD for "odd or unusual things," "read minds," "plans to hurt me," and "worsened functioning." Traumatic life events and age were significant predictors for all positive symptoms.

**Network estimation**

The symptom network revealed 148 of 276 possible edges were nonzero (54%), with the average layout shown in Figure 1. A post hoc Monte Carlo power analysis for cross-sectional network models (R package: powerly; 29) indicated a power of 0.87, given a sensitivity of 0.70, the sample size, and the number of nodes/edges.

 **Community analysis and bridge strength**

Communities aligned with the ITQ's factor structure, consistently revealing a three-community solution across all extractions. This suggests that the two dimensions of PTSD and DSO cluster separately, while psychosis symptoms form a third cluster. Item AD1 ("difficulties to calm down when upset") exhibited the highest bridge strength (see Figure 2).

**Network inference**

Item Hear-Own (‘hear own thoughts aloud’) had the highest strength centrality in the network (see Figure 2).

 **Network stability**

The edges showed satisfactory accuracy (Figure SM1, supplementary materials), and the centrality strength index demonstrated high accuracy (Figure SM2, supplementary materials). The stability coefficient for strength centrality exceeded the 0.5 cutoff for strong stability (16) at 0.75 (95% CI: 0.672–1). Similarly, edge accuracy was satisfactory (95% CI: 0.594–0.750).

**Group comparisons**

Figure SM3 (supplementary materials) presents the networks for high- and low-exposure groups. Global strength testing showed similar networks between the groups (p=·79), with comparable centrality indices (‘hear own thoughts aloud’ and ‘control’). Strength centrality and bridge graphs are in Figures SM4-SM5, and stability and accuracy in Figures SM6-SM7. The bridge symptom was affective dysregulation (“difficulties to calm down when upset”). Invariance testing revealed group differences, likely due to lower edge and centrality stability in the low-exposure group compared to satisfactory stability in the high-exposure group (see supplementary materials).

# **Discussion**

For most positive psychosis symptoms, we identified significant mean differences with small-medium effect sizes between participants who did not screen positive for PTSD/CPTSD and those with probable PTSD and CPTSD. The CPTSD group reported an even higher risk than the PTSD group in several individual domains (i.e., ‘odd or unusual things’, ‘read minds’, ‘plans to hurt me’, and ‘worsened functioning’). The results of the network analysis suggest three distinct communities of PTSD, DSO, and psychosis.

Affective dysregulation (‘difficulties to calm down when upset’) served as the bridging symptom between the communities. Centrality analysis showed that hearing one’s thoughts being said aloud was most central. This was replicated also when comparing groups with high and low trauma exposure. The networks showed high stability of the edges and good centrality accuracy. However, poorer stability was revealed in the low-exposure group, likely due to the weaker relevance of CPTSD and the small sample size.

In line with previous research 3,12,13, individuals who fulfilled the criteria of probable PTSD or CPTSD had a significantly higher severity of positive symptoms of psychosis compared to the no-disorder group. Notably, however, differences between CPTSD and PTSD only comprised the specific symptoms of ‘odd or unusual things’, ‘read minds’, ‘plans to hurt me’, and ‘worsened functioning’, which were significantly more severe in the CPTSD group relative to the PTSD group. This partially aligns with previous findings that identified differences between PTSD and CPTSD with regard to distress associated with psychosis symptoms severity 6,12. However, prior to our study, there had been limited exploration into the specific associations between individual CPTSD symptoms and individual psychosis symptoms. The present results suggest that specific psychosis symptoms may represent correlates of severe trauma sequelae (i.e. CPTSD). These symptom-specific associations highlight substantial qualitative differences between CPTSD and PTSD in how they relate to psychosis symptoms. Additionally, while this evidence lends partial support to the idea of a continuum extending from post-traumatic stress severity, incorporating (C)PTSD and including psychosis symptoms (e.g., worsened functioning) 3, it also underscores the importance of addressing specific psychosis-related symptoms that stand out (e.g., ‘read minds’, ‘plans to hurt me’).

DSO symptoms, core to CPTSD, may have contributed to the study's findings. For instance, DSO's interpersonal trust challenges could relate to psychosis-like symptoms like 'read minds', ‘odd or unusual things’, or 'plans to hurt me'. Similarly, beliefs of thought-reading or imminent harm align with DSO's heightened emotional responses and trust issues, which are characteristic features of DSO. Additionally, 'worsened functioning', indicating daily impairments, is often more severe in CPTSD than PTSD 30.Top of Form

Interestingly, belief in 'special or supernatural gifts' only differed between individuals with probable PTSD and those with probable CPTSD. This belief may reflect changes in self-concept beyond the scope of PTSD diagnosis. Individuals with probable CPTSD, who experienced altered self-concepts, affirmed these beliefs, supporting this speculation. However, existing literature suggests that such changes are typically negative, such as feeling diminished or worthless 7,31. Beliefs in special or supernatural gifts, however, suggest positive aspects of the self-concept or, possibly, posttraumatic growth experiences 32. Although there is a paucity of research linking CPTSD to posttraumatic growth, it could be speculated that based on the more fundamental posttraumatic changes in self-organization, posttraumatic growth may be more likely 32. However, more research is needed to better understand the potential relationship between CPTSD, posttraumatic growth, and psychotic-like experiences.

Three symptom communities were identified in the network, reflecting PTSD, DSO, and positive psychosis-like symptoms. This finding is in line with a previous study in which psychotic experiences and PTSD symptoms also formed separate clusters in their overall network 33. In the network analysis, 'difficulties to calm down when upset' (affective hyperactivation) showed the highest bridge strength, and also in both low and high exposure groups, underscoring its pivotal role in connecting symptom clusters. This indicates that in CPTSD, heightened emotional reactivity is a significant contributor to the co-occurrence of CPTSD and positive psychosis symptoms, aligning with research that links affective dysregulation to trauma exposure and psychosis 6,13 and that it is an important risk factor for the development of psychosis 34. For instance, dysfunctional affective regulation strategies were partly responsible for a stronger increase in paranoid beliefs following social stressor exposure in individuals at high risk of psychosis, compared to healthy controls and those with anxiety disorders 35. Affective dysregulation was linked to a stronger stress response in individuals with psychosis, recognized as a key risk factor in psychosis etiology Top of Form

36,37. These findings indicate that affective dysregulation may account for the high co-occurrence of CPTSD and positive psychosis-like symptoms, highlighting the need for interventions targeting affective hyperactivation in managing CPTSD and psychosis. However, further longitudinal research is required to understand the causal and temporal dynamics of this relationship.

Interestingly, network centrality did not coincide with bridge strength; centrality analysis showed that hearing one’s thoughts being said out loud (‘hear own thoughts aloud’) was the most central symptom in the network and thus the node with the strongest interconnectivity with all symptoms in the network. Hearing own thoughts aloud has been recognized as an associated feature of PTSD 31, which is supported by a strong body of evidence that found an association between voice hearing and traumatic memories 38. Pertinent to this connection, research also revealed relatively high rates of auditory hallucinations among people affected by PTSD 39. Moreover, some theorists contend that voice hearing reflects the essentially dissociative nature of a “normal” personality 40. That is, voice-hearing may not be the exclusive consequence of trauma exposure but an exaggeration of the universal experience of (negative) self-talk, potentially present in everyone and exacerbated following stress exposure 40. Nonetheless, evidence from a community sample showed that among the most frequently endorsed psychosis symptoms, hearing own thoughts aloud was one of the most distressing experiences 41. Therefore, hearing one’s thoughts aloud can be burdensome and clinicians should monitor this symptom, which has a significant impact on managing these conditions 40. Interventions targeting voice-hearing could be beneficial both among trauma and psychosis patients as well as at the sub-clinical level where it might be a preventive impact.

Several limitations should be acknowledged. Our study focused on positive rather than negative symptoms, potentially limiting the depth of understanding of the trauma-psychosis symptom relationship. Second, the use of self-report measures instead of clinician-administered interviews may introduce bias. Third, the cross-sectional study design does not allow temporal or causal inferences 42. The exact role of affect dysregulation (highest bridge strength) and hearing own thoughts (highest network centrality) in the network remains to be explored in future research. Finally, while the data approximately represent the Greater Montreal Area in terms of sex, age, and geolocation, it is not fully representative, which limits the generalizability of the study’s findings.

Despite its limitations, this study has important clinical implications. Findings show that positive symptoms of psychosis can be considered trauma-related responses in case of both low and high trauma exposure. Further, the findings accentuate the clinical importance of addressing both affective hyperactivation and auditory hallucinations in treating CPTSD with positive psychosis symptoms. Such focused interventions should abate these symptoms and thus prevent the development of future psychosis. These insights call for further research into the mechanisms of affective dysregulation and auditory symptoms in CPTSD and psychosis, to enhance clinical understanding and guide future research directions.

**Data access:** Available upon request and consideration

**Declaration of interest:** The Author(s) declare(s) that there is no conflict of interest.

**Funding:** An internal research grant was awarded to Menachem Ben-Ezra from Ariel University: RA1900000668. The sponsor had no involvement in study design, data collection, analysis, interpretation of the results, writing of the report or the decision to submit the article for publication.

**Ethics Statement:** This study was performed following the Declaration of Helsinki. This human study was approved by Ariel University - approval: 20191030. All adult participants provided written informed consent to participate in this study.Top of Form

**References**

1. Bailey T, Alvarez-Jimenez M, Garcia-Sanchez AM, et al. Childhood trauma is associated with severity of hallucinations and delusions in psychotic disorders: A systematic review and meta-analysis. Schizophr Bull 2018;44(5):1111–1122.

2. Buswell G, Haime Z, Lloyd-Evans B, et al. A systematic review of PTSD to the experience of psychosis: prevalence and associated factors. BMC Psychiatry 2021;21(1):1–13.

3. Frost R, Vang ML, Karatzias T, et al. The distribution of psychosis, ICD-11 PTSD and complex PTSD symptoms among a trauma-exposed UK general population sample. Psychosis 2019;11(3):187–198.

4. Ho GWK, Hyland P, Karatzias T, et al. Traumatic life events as risk factors for psychosis and ICD-11 complex PTSD: a gender-specific examination. Eur J Psychotraumatol 2021;12(1):2009271.

5. Achim AM, Maziade M, Raymond É, et al. How prevalent are anxiety disorders in schizophrenia? A meta-analysis and critical review on a significant association. Schizophr Bull 2011;37(4):811–821.

6. Mason AJC, Jung P, Kim S, et al. Associations between post-traumatic stress disorders and psychotic symptom severity in adult survivors of developmental trauma: a multisite cross-sectional study in the UK and South Korea. The Lancet Psychiatry 2023;10(10):760–767.

7. World Health Organization. International statistical classificaton of diseases and related health problems (11th ed.). 2019.

8. Maercker A, Cloitre M, Bachem R, et al. Complex post-traumatic stress disorder. Lancet 2022;400:60–72.

9. Frost R, Hyland P, McCarthy A, et al. The complexity of trauma exposure and response: Profiling PTSD and CPTSD among a refugee sample. Psychol Trauma Theory, Res Pract Policy 2019;11(2):165–175.

10. Linscott RJ, Van Os J. An updated and conservative systematic review and meta-analysis of epidemiological evidence on psychotic experiences in children and adults: On the pathway from proneness to persistence to dimensional expression across mental disorders. Psychol Med 2013;43(6):1133–1149.

11. Scott J, Chant D, Andrews G, et al. Association between trauma exposure and delusional experiences in a large community-based sample. Br J Psychiatry 2007;190:339–343.

12. Rossi R, Socci V, D’Aurizio G, et al. Psychotic-like experiences associated with ICD-11 PTSD and cPTSD in a cohort of Italian late adolescents. Riv Psichiatr 2023;58(3):123–128.

13. Panayi P, Berry K, Sellwood W, et al. The role and clinical correlates of complex post-traumatic stress disorder in people with psychosis. Front Psychol 2022;13:791996.

14. Eaton NR. Latent variable and network models of comorbidity: toward an empirically derived nosology. Soc Psychiatry Psychiatr Epidemiol 2015;50:845–849.

15. Epskamp S, Borsboom D, Fried EI. Estimating psychological networks and their accuracy: A tutorial paper. Behav Res Methods 2018;50(1):195–212.

16. Jones PJ, Ma R, McNally RJ. Bridge centrality: A network approach to understanding comorbidity. Multivariate Behav Res 2021;56(2):353–367.

17. Hardy A, O’Driscoll C, Steel C, et al. A network analysis of post-traumatic stress and psychosis symptoms. Psychol Med 2021;51(14):2485–2492.

18. Statistics Canada. Sex at birth and gender of people in Canadahttps://www.statcan.gc.ca/o1/en/plus/2052-sex-birth-and-gender-people-canada (2022, accessed December 5, 2024).

19. Cloitre M, Shevlin, Brewin CR, et al. The International Trauma Questionnaire: development of a self-report measure of ICD-11 PTSD and complex PTSD. Acta Psychiatr Scand 2018;138(6):536–546.

20. Mamah D, Mbwayo A, Mutiso V, et al. A survey of psychosis risk symptoms in Kenya. Compr Psychiatry 2012;53(5):516–524.

21. Miller TJ, Cicchetti D, Markovich D, et al. The SIPS Screen: a brief self-report screen to detect the schizophrenia prodrome. *Schizophrenia Research*;70.

22. Kobayashi H, Nemoto T, Koshikawa H, et al. A self-reported instrument for prodromal symptoms of psychosis: Testing the clinical validity of the PRIME Screen-Revised (PS-R) in a Japanese population. Schizophr Res 2008;106(2–3):356–362.

23. Epskamp S, Cramer AOJ, Waldorp LJ, et al. Qgraph: Network visualizations of relationships in psychometric data. J Stat Softw 2012;48(4):1–8.

24. Friedman J, Hastie T, Tibshirani R. Sparse inverse covariance estimation with the graphical lasso. Biostatistics 2008;9(3):432–441.

25. Foygel R, Drton M. Extended Bayesian information criteria for Gaussian graphical models. Adv Neural Inf Process Syst 2010;23:604–612.

26. Hofmann SG, Curtiss J, McNally RJ. A complex network perspective on clinical science. Perspect Psychol Sci 2016;11(5):597–605.

27. Yang Z, Algesheimer R, Tessone CJ. A comparative analysis of community detection algorithms on artificial networks. Sci Rep 2016;6(1):30750.

28. Jones PJ. Package “networktools”. CRAN-Rhttps://cran.r-project.org/web/packages/networktools/networktools.pdf (2018).

29. Constantin MA, Schuurman NK, Vermunt JK. A general Monte Carlo method for sample size analysis in the context of network models. Psychol Methods 2023;(Advanced online publication).

30. Karatzias T, Shevlin M, Fyvie C, et al. Evidence of distinct profiles of Posttraumatic Stress Disorder (PTSD) and Complex Posttraumatic Stress Disorder (CPTSD) based on the new ICD-11 Trauma Questionnaire (ICD-TQ). J Affect Disord 2017;207:181–187.

31. Brewin CR. Complex post-traumatic stress disorder: a new diagnosis in ICD-11. BJPsych Adv 2020;26:145–152.

32. Tedeschi RG, Calhoun LG. Posttraumatic growth: conceptual foundations and empirical evidence. Psychol Inq 2004;15(1):1–18.

33. Wright LA, McElroy E, Barawi K, et al. Associations among psychosis, mood, anxiety, and posttraumatic stress symptoms: A network analysis. J Trauma Stress 2023;36:385–396.

34. Ludwig L, Werner D, Lincoln TM. The relevance of cognitive emotion regulation to psychotic symptoms – A systematic review and meta-analysis. Clin Psychol Rev 2019;72:101746.

35. Lincoln TM, Sundag J, Schlier B, et al. The relevance of emotion regulation in explaining why social exclusion triggers paranoia in individuals at clinical high risk of psychosis. Schizophr Bull 2018;44(4):757–767.

36. Lincoln TM, Hartmann M, Köther U, et al. Dealing with feeling: Specific emotion regulation skills predict responses to stress in psychosis. Psychiatry Res 2015;228(2):216–222.

37. Pruessner M, Cullen AE, Aas M, et al. The neural diathesis-stress model of schizophrenia revisited: An update on recent findings considering illness stage and neurobiological and methodological complexities. Neurosci Biobehav Rev 2017;73:191–218.

38. McCarthy-Jones S, Trauer T, MacKinnon A, et al. A new phenomenological survey of auditory hallucinations: Evidence for subtypes and implications for theory and practice. Schizophr Bull 2014;40(1):225–235.

39. Anketell C, Dorahy MJ, Shannon M, et al. An exploratory analysis of voice hearing in chronic PTSD: Potential associated mechanisms. J Trauma Dissociation 2010;11(1):93–107.

40. Longden E, Madill A, Waterman MG. Dissociation, trauma, and the role of lived experience: Toward a new conceptualization of voice hearing. Psychol Bull 2012;138(1):28–76.

41. Mongan D, Shannon C, Hanna D, et al. The association between specific types of childhood adversity and attenuated psychotic symptoms in a community sample. Early Interv Psychiatry 2019;13(2):281–289.

42. Bodas M, Siman-Tov M, Kreitler S, et al. Psychological correlates of civilian preparedness for conflicts. Disaster Med Public Health Prep 2017;11(4):451–459.

Table 1. Item Level Descriptive Statistics for the ITQ and mPrime and Correlation with Total Trauma (ITEM).

|  |  |  |  |
| --- | --- | --- | --- |
|  | Mean | SD | Correlation with ITEM |
| **PTSD** |  |  |  |
| Re1. Having upsetting dreams | 1.34 | 1.26 | .34\*\*\* |
| Re2. Having powerful images  | 1.44 | 1.27 | .32\*\*\* |
| Av1. Avoiding internal reminders  | 1.47 | 1.30 | .38\*\*\* |
| Av2. Avoiding external reminders  | 1.45 | 1.34 | .37\*\*\* |
| SoT1.Being “super-alert”,  | 1.70 | 1.40 | .33\*\*\* |
| SoT2. Feeling jumpy or easily startled? | 1.55 | 1.34 | .40\*\*\* |
| **DSO** |  |  |  |
| Ad1. Long time to calm down. | 1.63 | 1.20 | .25\*\*\* |
| Ad2. I feel numb or emotionally shut down. | 1.58 | 1.30 | .33\*\*\* |
| NSC1. I feel like a failure. | 1.46 | 1.37 | .31\*\*\* |
| NSC2. I feel worthless. | 1.35 | 1.36 | .30\*\*\* |
| DiR1. I feel distant or cut off from people. | 1.60 | 1.33 | .30\*\*\* |
| DiR2. I find it hard to stay emotionally close  | 1.53 | 1.31 | .30\*\*\* |
|  |  |  |  |
| **Psychosis-risk symptoms** |  |  |  |
| Odd or unusual things | 2.90 | 1.81 | .15\*\*\* |
| Predict the future | 2.18 | 1.78 | .29\*\*\* |
| Controlling thoughts | 2.28 | 1.85 | .31\*\*\* |
| Superstitions | 2.31 | 1.85 | .32\*\*\* |
| Real or imagination | 2.33 | 1.83 | .32\*\*\* |
| Read minds | 2.19 | 1.86 | .36\*\*\* |
| Plans to hurt me | 2.24 | 1.92 | .37\*\*\* |
| Special or supernatural gifts | 2.18 | 1.94 | .34\*\*\* |
| Worsened functioning | 2.19 | 1.90 | .37\*\*\* |
| Hearing people talking | 2.03 | 1.92 | .34\*\*\* |
| Hearing own thoughts | 2.07 | 1.92 | .35\*\*\* |
| Going mad | 2.14 | 1.96 | .39\*\*\* |
| **ITEM total** | 8.91 | 5.30 | - |

# Table 2. Frequency of symptom endorsement (*N* = 747)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Symptoms |  | Endorsement (%) |  |  |  |
| PTSD | Re-experiencing | 27.0 |  |  |  |
|  | Avoidance | 29.5 |  |  |  |
|  | Sense of threat | 34.9 |  |  |  |
| DSO | Affective dysregulation | 33.8 |  |  |  |
|  | Negative self-concept | 28.9 |  |  |  |
|  | Difficulties in relationships | 33.1 |  |  |  |
| Psychosis-risk symptoms | **No-disorder** ***M* (*SD*)** | **PTSD*****M* (*SD*)** | **CPTSD*****M* (*SD*)** | **F (4, 831)** | **Effect size** |
| 1. Odd or unusual things | 2.72 (1.75) a | 3.78 (1.72) b | 4.68 (1.53) c | 33.76\*\*\* | .09 |
| 2. Predict the future | 2.01 (1.68) a | 2.95 (1.95) b | 3.81 (1.99) b | 23.05\*\*\* | .08 |
| 3. controlling thoughts, feelings, action | 2.07 (1.75) a | 3.37 (1.75) b | 4.17 (1.89) b | 33.83\*\*\* | .10 |
| 4. Superstitions | 2.13 (1.74) a | 3.63 (1.88) b | 3.66 (2.22) b | 21.12\*\*\* | .08 |
| 5. Real or imagination | 2.11 (1.72) a | 3.38 (1.81) b | 4.34 (1.78) b | 37.95\*\*\* | .11 |
| 6. Read minds | 2.00 (1.76) a | 2.85 (1.89) b | 4.07 (1.85) c | 25.47\*\*\* | .09 |
| 7. Plans to hurt me | 2.02 (1.80) a | 2.95 (1.99) b | 4.58 (1.59) c | 40.91\*\*\* | .12 |
| 8. Special or supernatural gifts | 2.00 (1.83) a | 2.73 (2.09) a | 4.15 (2.09) c | 24.90\*\*\* | .09 |
| 9. Worsened functioning | 1.95 (1.76) a | 3.10 (1.92) b | 4.64 (1.61) c | 51.63\*\*\* | .14 |
| 10. Hearing people talking | 1.84 (1.80) a | 3.10 (2.18) b | 3.66 (2.23) b | 21.54\*\*\* | .08 |
| 11. Hearing own thoughts | 1.82 (1.77) a | 3.47 (2.06) b | 4.24 (1.91) b | 46.49\*\*\* | .13 |
| 12. Going mad | 1.88 (1.81) a | 3.40 (2.04) b | 4.53 (1.75) b | 49.29\*\*\* | .14 |

*Notes*. Endorsement is the rates of individuals that reached criteria ≥2. All F statistics were significant at the level of 0.0001. Different uppercase letters represent significant group differences while similar uppercase letters represent similar (non-significant) group differences. \*\*\* *p* <.0001





Fig 2. **Strength bridge (left figure) and Strength Centrality (right figure).**