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Article

Symptom-Context Networks Across Subclinical Psychosis Risk in Adolescents

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ABSTRACT

Background/aim: Psychotic disorders stem from complex interactions among genetic, environmental, and socio-emotional factors. While the Clinical High-Risk for Psychosis (CHR-P) criteria help identify at-risk youth, their scalability may be limited. The Psychosis Risk Score (PRS), a self-report–based algorithmic index, offers a complementary, dimensional method for detecting adolescents at subclinical risk. Network theory views mental disorders as dynamic systems of interacting symptoms and contextual processes. This study uses a network approach to examine how emotional and contextual factors interact across PRS-defined risk levels, aiming to identify early intervention targets. **Methods:** 1,773 adolescents were selected through stratified cluster sampling. Three networks were estimated: all participants, PRS-Risk (high and moderate), and PRS-No Risk. **Results**: In the full-sample model, PRS showed notable betweenness centrality (1.31), suggesting a bridging role between contextual and emotional factors. Psychological Inflexibility (PI) was the most central node (strength = 1.64), highlighting its transdiagnostic relevance. In the PRS-Risk network, PI and Depression anchored a tightly interconnected emotional cluster. Trauma, despite lower strength, maintained cross-domain links. By contrast, the PRS-No Risk network was more loosely connected and lacked integrative features. **Conclusions:** Targeting PI may be critical for preventing psychopathology in at-risk adolescents, while addressing trauma could help mitigate contextual vulnerabilities.

Redes de Síntomas y Contexto en Adolescentes con Riesgo Subclínico de Psicosis

Palabras clave:
Riesgo de psicosis
Análisis de redes
Adolescentes
Trauma
Inflexibilidad Psicológica (PI)

RESUMEN

Antecedentes/Objetivos: Los trastornos psicóticos surgen de interacciones complejas entre factores genéticos, ambientales y socioemocionales. Aunque los criterios de Alto Riesgo Clínico de Psicosis (CHRp) identifican jóvenes en riesgo, su escalabilidad puede verse limitada. El *Psychosis Risk Score* (PRS), índice algorítmico basado en autoinformes, ofrece un método dimensional complementario para detectar adolescentes con riesgo subclínico. La teoría de redes concibe los trastornos mentales como sistemas dinámicos de síntomas y contexto. Este estudio explora cómo factores emocionales y contextuales interactúan según niveles de riesgo definidos por PRS, para identificar dianas de intervención temprana. **Método:** Se seleccionaron 1.773 adolescentes mediante muestreo por conglomerados estratificado. Se estimaron tres redes: todos los participantes, PRS-Riesgo (alto y moderado) y PRS-Sin Riesgo. **Resultados:** En el modelo completo, PRS mostró alta centralidad de intermediación (1,31), sugiriendo un papel de puente entre factores contextuales y emocionales. Inflexibilidad Psicológica (PI) fue el nodo más central (fuerza = 1,64), destacando su relevancia transdiagnóstica. En PRS-Riesgo, PI y Depresión anclaron un *cluster* emocional interconectado, mientras Trauma mantuvo vínculos entre dominios. La red PRS-Sin Riesgo, más dispersa, careció de rasgos integradores. **Conclusiones:** Intervenciones dirigidas a PI pueden ser clave para prevenir psicopatología en adolescentes en riesgo, mientras abordar trauma podría mitigar vulnerabilidades contextuales.

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Introduction

Clinical High-Risk for psychosis (CHR-P) criteria are commonly used to identify adolescents at increased risk of developing psychosis and are situated within a broader clinical staging framework (Fusar-Poli et al., 2013; McGorry et al., 2006). Based on structured clinical interviews, their clinical utility has been widely validated, consistently demonstrating strong predictive accuracy for identifying individuals at elevated likelihood of transition and informing early intervention strategies (Fusar-Poli et al., 2020). At the same time, a recent meta-analysis showed that adolescents meeting CHR-P criteria frequently experience comorbid conditions (Catalan et al., 2020), complicating treatment planning. For example, emotional symptoms—highly prevalent in at-risk youth—have been linked to negative symptoms and poorer remission rates (Li et al., 2020; Paino-Piñeiro et al., 2008; Schirmbeck et al., 2022).

Traditional models of psychopathology have often conceptualized psychosis as a latent disease process, with symptoms reflecting a single underlying condition. Yet no single causal mechanism has been identified, supporting the view that psychosis is inherently multicausal (Fried, 2015; van Rooijen et al., 2017). This has prompted growing interest in dimensional and data driven alternatives. Among these, algorithm-derived classifications group adolescents into low, moderate, or high risk based on self-reported symptoms and functioning (Paino et al., 2022a, 2022b). The *Psychosis Risk Score* (PRS) operationalizes this approach and aligns conceptually with recent models such as the *Psychosis Polyrisk Score* (PPS; Oliver et al., 2019) and the *Korean Polyenvironmental Risk Score* (K-PERS; Jeon et al., 2022).

Network theory offers a dynamic framework that understands mental disorders as systems of mutually reinforcing symptoms. Studies have shown strong interconnections not only among psychotic symptoms but also with affective and contextual features (Borsboom, 2017; Freeman et al., 2022; Rigby & McCabe, 2021). Previous network studies have further demonstrated that psychosis-related symptom structures may differ across trauma exposure, environmental burden, and transdiagnostic symptom profiles. For example, Isvoranu et al. (2017) identified distinct associations between specific forms of childhood trauma and psychotic symptoms, supporting differentiated trauma-related pathways to psychosis vulnerability. Similarly, broader transdiagnostic and contextual network approaches suggest that affective symptoms and general psychopathology may play an important role in linking environmental stressors to psychotic experiences (Betz et al., 2020; Wigman et al., 2017). However, little is known about how these dynamics manifest in subclinical populations. Clarifying how emotional and contextual variables cluster and interact in at-risk adolescents may help identify early vulnerability pathways.

Recent evidence shows that common emotional symptoms, particularly depression and anxiety, explain 22 percent of the variance in psychosis risk, while contextual factors such as trauma and migration account for an additional 9 percent (Fernández et al., 2024). These findings echo broader evidence on the impact of affective and environmental variables in psychosis vulnerability (Fusar-Poli et al., 2017). More specifically, emerging work suggests that affective factors play an important role in early psychosis pathways, with depressed mood extending beyond a purely comorbid symptom (Mavindidze et al., 2025). Similarly, evidence linking daily affective states to psychotic experiences (Senín-Calderón et al., 2016; van der Tuin et al., 2024) reinforces the relevance of affective processes during the early stages of psychosis vulnerability.

In parallel, psychological inflexibility (PI), a broad construct derived from *Acceptance and Commitment Therapy* (ACT), has gained attention as a possible mechanism linking emotional distress and psychotic-like symptoms. Within this framework, experiential avoidance is considered one of the central components of PI and refers to attempts to avoid, suppress, or control unwanted internal experiences, such as thoughts, emotions, bodily sensations, or memories, even when doing so entails psychological or behavioral costs.

PI is frequently operationalized using the *Acceptance and Action Questionnaire-II* (AAQ-II), a widely used instrument that primarily captures experiential avoidance and individuals' unwillingness to remain in contact with unwanted private experiences. Previous studies employing AAQ-II scores—or closely related experiential avoidance measures—have linked PI/experiential avoidance to psychotic-like experiences (Moran et al., 2021), paranoid ideation (Udachina et al., 2009), emotional distress (Mellick et al., 2019), and self-stigma (González-Menéndez et al., 2021). Recent evidence also suggests that AAQ-II-assessed PI may statistically mediate relationships between subclinical psychosis and depressive and anxiety symptoms (Fernández et al., 2025; Núñez et al., 2021). However, the conceptual and psychometric specificity of the AAQ-II remains under debate, particularly regarding whether it captures PI or experiential avoidance specifically, or whether it partly reflects general psychological distress (McLoughlin & Roche, 2023; Ong et al., 2019).

In this study, the network-analytic approach and the psychosis risk score (PRS) are conceptualized as complementary tools within the framework of CHR-P criteria. The PRS offers a dimensional perspective on vulnerability, while the network approach captures how emotional and contextual processes interact across different levels of risk. Guided by empirical evidence and theoretical models, including Garety's cognitive framework (Garety et al., 2001) —which emphasizes trauma and maladaptive coping in psychosis— we examined the structure of symptom-context networks in adolescents stratified by subclinical psychosis risk using the PRS index. Here, symptoms are broadly defined to include emotional states and transdiagnostic processes such as depression, anxiety, and PI. Finally, we compared network structures between moderate-to-high risk (PRS-Risk) and low-risk (PRS-No Risk) groups to identify central and bridging nodes that may serve as early clinical markers.

Method

Participants and Procedure

The target population consisted of students aged 14 to 18 years enrolled in educational centers from northern Spain. From an official registry of approximately 32,000 students, a representative sample of 1,824 adolescents was selected, from thirty-seven schools that agreed to participate. Sampling followed a stratified probability cluster design, using classrooms as primary units and stratifying by school type (public vs. publicly funded private schools) and educational program (middle school, high school, and vocational

training). The procedure was designed and implemented by experts from the regional education authority.

Data were collected via online questionnaires completed on computers or tablets under the supervision of trained researchers. Written informed consent was obtained from legal guardians, and the study received approval from the local Clinical Research Ethics Committee (see Institutional Review Board Statement).

To ensure data quality, invalid responses were first excluded using the INF-OV scale (Fonseca-Pedrero et al., 2009). Cases with missing values —representing 2,8% of the initial dataset —were then removed through listwise deletion, a common approach in Gaussian Graphical Model (GGM) stimation to maintain a positive definite partial correlation matrix. This strategy supports stable network estimation and resulted in a final analytic sample of 1,773 participants (JASP Team, 2020).

Measures

Psychosis Risk Score (PRS). The PRS was computed using a three-track algorithm (Paino et al., 2022a, 2022b) that integrates key risk indicators —ultra-high risk (UHR; Yung & Mcgorry, 1996), basic symptoms (BS; Huber & Gross, 1989), and anomalous self-experiences (ASE; Koren et al., 2020) —along with global functioning (GF) deficits. This algorithm relies on brief, validated self-report instruments with strong psychometric properties in adolescents, including the Spanish version of the *Prodromal Questionnaire-Brief Version* (PQ-B; Fonseca-Pedrero et al., 2016; Loewy et al., 2011; α = .93), the *Frankfurt-Pamplona Subjective Experience Scale* (EEFP; Cuesta et al., 1995; α = 0.91), the *Self-Experience Lifetime Frequency Scale* (SELF; Heering et al., 2016; α = .79–.88), and the *Global Functioning: Social and Role scales* (GF: Social & GF: Role; Cornblatt et al., 2007; α = .88). Each track yields a partial score, and their combination produces an ordinal index ranging from 0 (*low risk*) to 2 (*high risk*). This method offers a dimensional, scalable alternative to traditional CHR-P assessments and does not require structure interviews. In the full-sample network, PRS was included as an ordinal node to preserve its structural information. For subgroup analyses, PRS was dichotomized (0 = *no risk*; 1 = *moderate/high risk*) and used exclusively for stratification purposes.

Traumatic Experiences Screening Questionnaire (ExpTra-S; Paino et al., 2020). The ExpTra-S is a brief, psychometrically validated self-report tool for assessing childhood trauma, including abuse and neglect. It uses two 18-item Likert scales (frequency and distress) and has shown excellent internal consistency (α = .96).

Family Affluence Scale (FAS-II; Boyce et al., 2006). This valid 4-item measure of family socioeconomic status provides scores from 0 (*lowest*) to 7 (*highest*). It correlates strongly with the *Gross Domestic Product* (GDP) (0.87) and has an acceptable Kappa index (0.57). Additionally, *Academic Performance* was assessed via a self-report item on average academic grade in the previous academic year, recorded on a 5-point Likert scale (from 0 = *Fail* to 4 = *Outstanding*), yielding a continuous indicator of perceived academic achievement.

Depression, Anxiety, and Stress Scale-21 (DASS-21; Lovibond & Lovibond, 1995). The DASS-21 assesses emotional symptoms across three subscales: Stress, Anxiety and Depression. It includes 21 items rated on a 4-point Likert scale (0-3) and has shown excellent internal consistency in Spanish samples (α = .91; Bados et al., 2005).

Acceptance and Action Questionnaire (AAQ-II; Bond et al., 2011; Spanish validation by Ruiz et al., 2013). The AAQ-II assesses psychological inflexibility (PI) seven items rated on a 7-point Likert scale. It is widely used as a brief measure of psychological inflexibility (PI), although its items primarily capture experiential avoidance and unwillingness to remain in contact with unwanted private experiences. Accordingly, in the present study, AAQ-II scores were interpreted as an AAQ-II-based indicator of PI, with a prominent experiential avoidance component. It has shown good reliability in Spanish samples (α = .88; Ruiz et al., 2013). Higher scores reflect greater PI, though its ability to distinguish PI from general negative affect has been questioned (Ong et al., 2019).

Oviedo Infrequency Scale (INF-OV; Fonseca-Pedrero et al., 2009). The INF-OV detects random or careless responding using 12 self-report items rated on a Likert scale. Participants with more than two incorrect responses were excluded. This tool has demonstrated validity and has been used in adolescent samples (Fonseca-Pedrero et al., 2009; Paino et al., 2022a).

Data Analysis

Prior to network estimation, descriptive statistics were calculated for all sociodemographic, clinical, and contextual variables stratified by PRS group (PRS-Risk vs. PRS-No Risk). For the pertinent continuous variables, between-group differences were assessed using independent-samples t-tests, and effect sizes were calculated using Cohen's d.

In this study we applied a network approach to investigate the interrelations among contextual (trauma, academic performance, and socioeconomic status) and emotional (PI, Depression, and Anxiety) variables, and the Psychosis Risk Score (PRS), a single composite indicator algorithmically derived from UHR, BS, ASE, and functional deficits. Three networks were constructed: one for the full sample (n = 1,773)**,** offering a general overview; one for PRS-No Risk participants (n = 1,257); and one for PRS-Risk adolescents (n = 516). This design allows comparative analyses to highlight structural and connectivity differences between risk groups and to identify potential early markers. As these are cross-sectional analyses, the observed associations between nodes reflect contemporaneous relationships and do not imply causality.

For network estimation, we used a Bayesian Gaussian Copula Graphical Model (GCGM) (Williams et al., 2021), implemented in JASP software (JASP Team, 2020). This approach accommodates both ordinal and continuous variables by estimating latent correlations through a copula transformation. The resulting network is undirected and represents conditional associations between variables without implying causality. Edges are displayed in blue for positive associations and red for negative ones, with thickness proportional to the posterior mean of the edge weight.

Because this is a Bayesian model, uncertainty was derived directly from the posterior distribution. Consequently, bootstrapping procedures were not required. Instead, 95% credibility intervals were computed for the centrality indices, serving as the Bayesian analogue to traditional confidence intervals (Williams et al., 2021).

Node importance was assessed using three centrality indices calculated in JASP (Opsahl et al., 2010): strength, defined as the sum

of absolute edge weights and reflecting a node's overall connectivity; closeness, indicating how easily a node can be reached from others; and betweenness, measuring how frequently a node lies on the shortest path between pairs of other nodes. Among these, strength is generally considered the most robust and interpretable metric in psychopathology networks.

We opted not to apply the Network Comparison Test (NCT) because the model used—the Bayesian Gaussian Copula Graphical Model (GCGM)—is not directly compatible with NCT, which was originally developed for networks estimated via GLASSO. Instead, network structures, densities, and centrality patterns were compared through Bayesian credibility inspection and graphical analysis, an approach considered appropriate for mixed latent models.

All network procedures adhered to current best-practice guidelines for psychological network analysis (Borsboom, 2017; Epskamp et al., 2017).

Results

Descriptive Results and Between-Groups Comparisons

Descriptive statistics for sociodemographic and clinical variables are presented in Table 1, stratified by psychosis risk level (PRS-Risk/No Risk). Sex and nationality were included for descriptive sample characterization only, whereas inferential between-group comparisons were conducted for age as well as for the primary clinical and contextual variables most relevant to the study objectives. Of the total sample (1,773), 516 participants met criteria for medium ($n = 448$) to high risk ($n = 68$). Pairwise deletion was used to handle item-level missing data, which resulted in slight variation in valid n across variables (see Table 1).

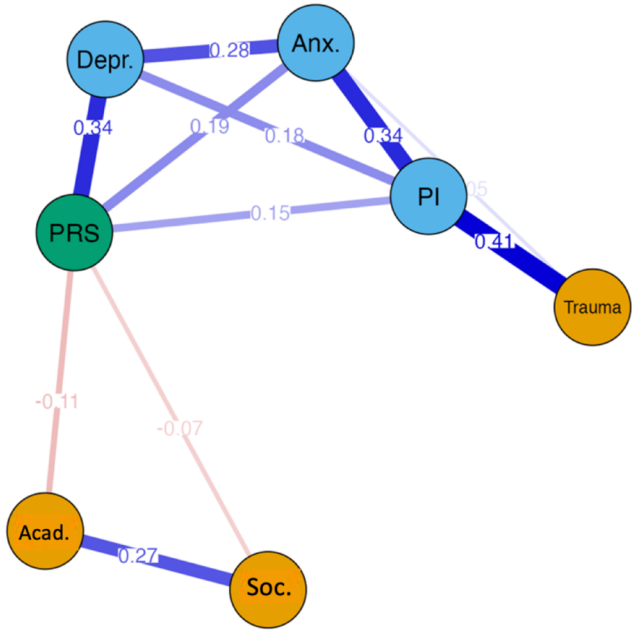
No significant differences were observed between groups in age ($p = .164$). Group comparisons revealed statistically significant differences between PRS-Risk and PRS-No Risk adolescents across all primary variables assessed (all $p < .001$). The largest effect sizes were observed for PI, depression, and anxiety, respectively, followed by trauma, which showed a moderate effect size. In contrast, academic performance and socioeconomic status demonstrated comparatively smaller effects. These findings are consistent with the greater emotional and transdiagnostic burden associated with PRS-Risk status.

Network Analysis: Entire Sample Network

Figure 1 shows the estimated network structure for the entire sample, including adolescents across the full spectrum of psychosis risk (PRS). The network was selectively connected, with no isolated nodes. Although PRS did not exhibit high strength centrality, it showed direct links to both emotional symptoms (e.g., depression, anxiety, and PI) and contextual factors (e.g., socioeconomic status, academic performance), indicating a cross-domain integrative role.

Figure 2 displays the centrality metrics. PI clearly emerged as the most central and influential node, with the highest strength (1.64) and expected influence (1.60), indicating its broad impact across domains. Trauma, although originally conceptualized as a contextual factor, showed stronger associations with emotional symptoms than with the

Figure 1
Entire Sample Network



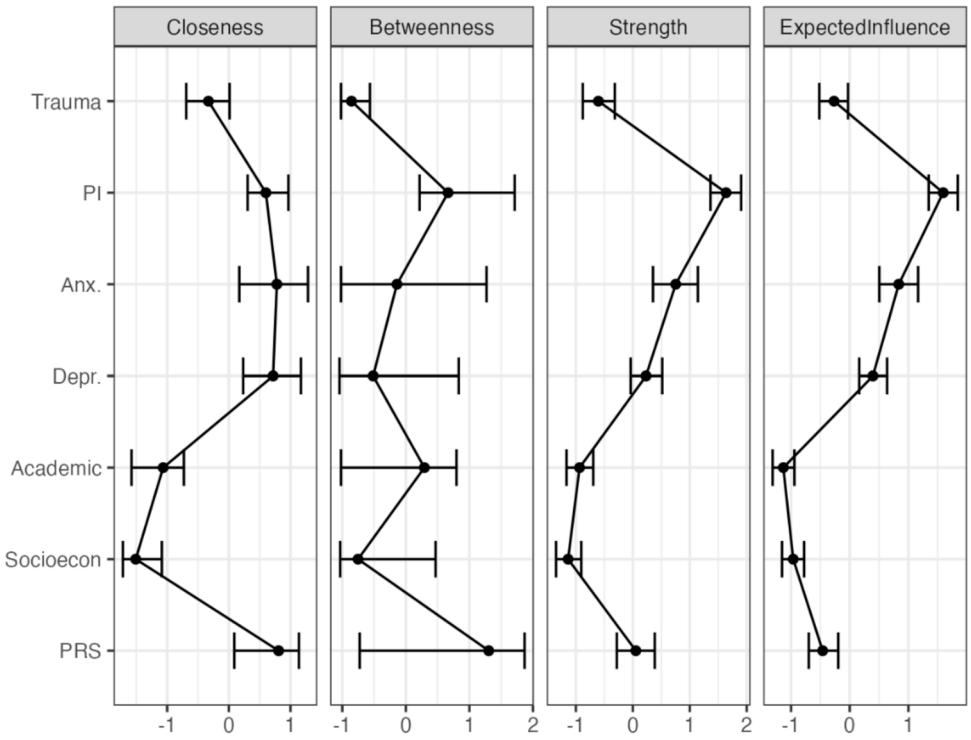
Note. PRS: Psychosis Risk Score; Soc: Socioeconomic status; Acad: Academic performance; PI: Psychological Inflexibility; Anx: Anxiety; Depr: Depression.

Table 1
Descriptive and Between-Group Comparison Statistics by PRS Classification

	PRS-Risk ($n = 516$)	PRS-No Risk ($n = 1257$)	t	Cohen's d
Age, years (14-19)	15.73 (1.25)	15.83 (1.25)	1.39	0.073
Sex (female n (%))	280 (54.3)	673 (53.5)		
Nation. (non-Spanish n (%))	50 (9.7)	60 (4.8)		
Trauma (0-3)	1.53 (1.27)	0.95 (1.21)	-8.36***	0.469
Academic (0-4)	2.34 (1.19)	2.62 (1.05)	4.65***	0.259
Socioecon. (0-7)	5.19 (1.42)	5.45 (1.28)	3.53***	0.197
PI (7-49)	26.55 (11.71)	15.98 (8.96)	-20.34***	1.075
Depression (0-42)	17.84 (11.50)	8.01 (8.04)	-20.29***	1.072
Anxiety (0-42)	15.95 (10.54)	7.63 (7.52)	-18.55***	0.978

Note. PRS-Risk includes adolescents with algorithm scores of 1 (moderate risk; $n = 448$) or 2 (high risk; $n = 68$) risk), whereas PRS-No Risk includes adolescents with score: 0 (*low/no risk*); valid *n* can vary across variables due to missing data; *M* : Mean; *SD*: Standard Deviation; *t*: independent samples *t*-test; ***$p < .001$; Nation: Nationality; Academic: Academic performance; Socioecon: Socioeconomic status; PI: Psychological Inflexibility.

Figure 2
Entire Sample Network Centrality Indexes



Note. PI: Psychological Inflexibility; Anx: Anxiety; Depr: Depression; Academic: Academic performance; Socioecon: Socioeconomic status; PRS: Psychosis Risk Score.

other contextual variables, aligning more closely with the affective domain. Its strongest connection was with PI (edge weight = 0.41), reinforcing its emotional positioning in the network. Despite being peripheral in terms of overall strength, this pattern suggests that trauma is functionally embedded within the emotional domain.

Network Analyses: PRS Split Networks

Figure 3 compares the networks separately for adolescents with moderate-to-high (PRS-Risk) and low (PRS-No Risk) subclinical psychosis risk. Both networks display selectively connected structures, with emotional symptoms forming tightly clustered groups and contextual variables remaining peripheral —replicating the pattern observed in the full sample.

A key difference between the two networks involves the role of trauma. In the PRS-Risk group, trauma was directly connected to both contextual (academic performance) and emotional (PI, anxiety) variables, suggesting a bridging function across domains. In contrast, in the PRS-No Risk network, trauma was linked only to emotional symptoms, with no connections to contextual factors. This mirrors the structure found in the full sample, where trauma appeared functionally embedded in the emotional domain.

Figure 4 illustrates shifts in node centrality across adolescents with and without psychosis risk. PI remained the only node with consistently high closeness across both groups (0.78 in PRS-Risk; 0.76 in PRS-No Risk), confirming its central structural role. In the PRS-Risk group, Depression emerged as the most influential node, showing the highest strength (1.55), expected influence (1.46), and closeness (0.58). In the PRS-No Risk group, its centrality remained high but was slightly lower (e.g., strength = 1.48). Anxiety, although moderately central in both groups (e.g., closeness = 0.43 and 0.40), did not emerge as a key node compared to PI or Depression.

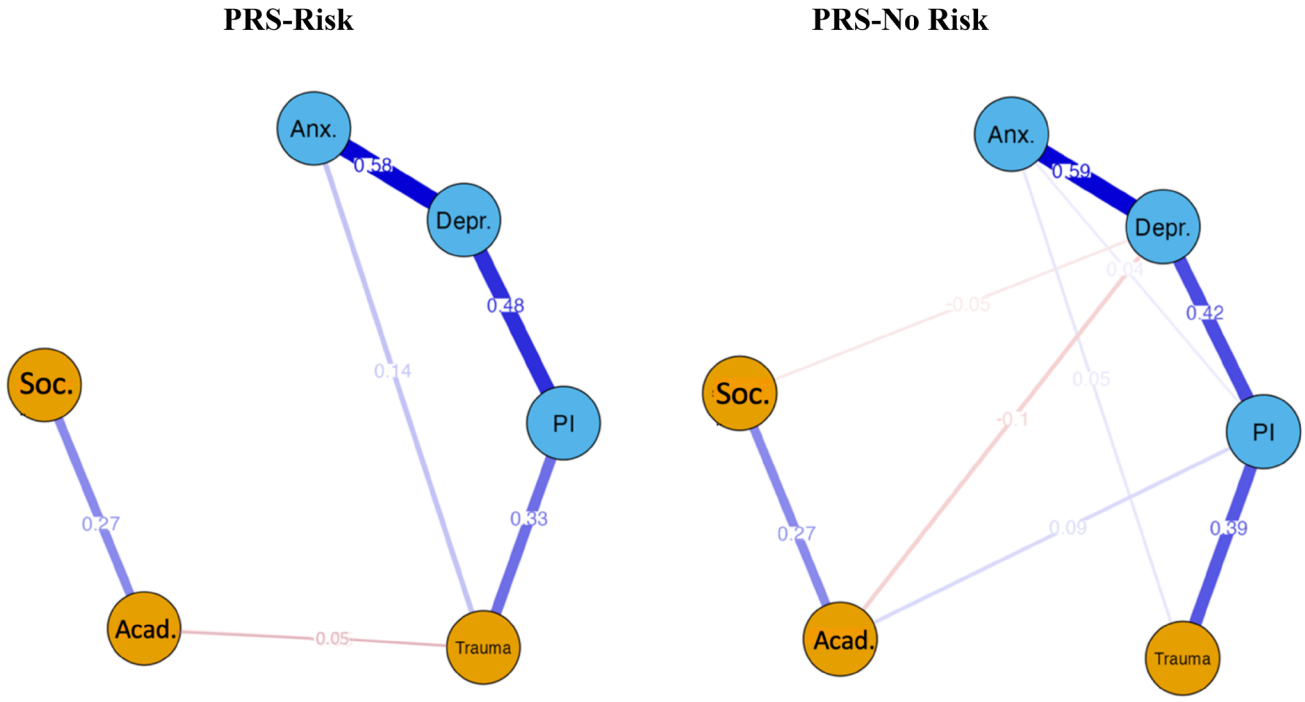
Trauma showed a marked shift: while peripheral in the PRS-No Risk group (e.g., betweenness = -0.86), it became more structurally integrated in the PRS-Risk network, with increased closeness (0.68) and strong ties to emotional symptoms—again reflecting the pattern observed in the full sample.

Robustness Analysis

Given the Bayesian framework of the current model, robustness was assessed through the examination of posterior distributions (see Figures 2 & 4). In the network estimated from the entire sample, the 95% credibility intervals for centrality indices indicate relatively precise estimates for PI and Depression, particularly in terms of strength. This supports their structural relevance within the overall network. In contrast, wider intervals for other variables —such as Trauma— reflect greater uncertainty, warranting more cautious interpretation. In both PRS-No Risk and PRS-Risk networks, Trauma and PI show the most robust centrality estimates, with narrow 95% credibility intervals that remain well above zero—particularly for strength and closeness. In contrast, Academic performance**,** Socioeconomic status**,** and in some cases Depression**,** display wider intervals that often include zero, indicating lower

Figure 3

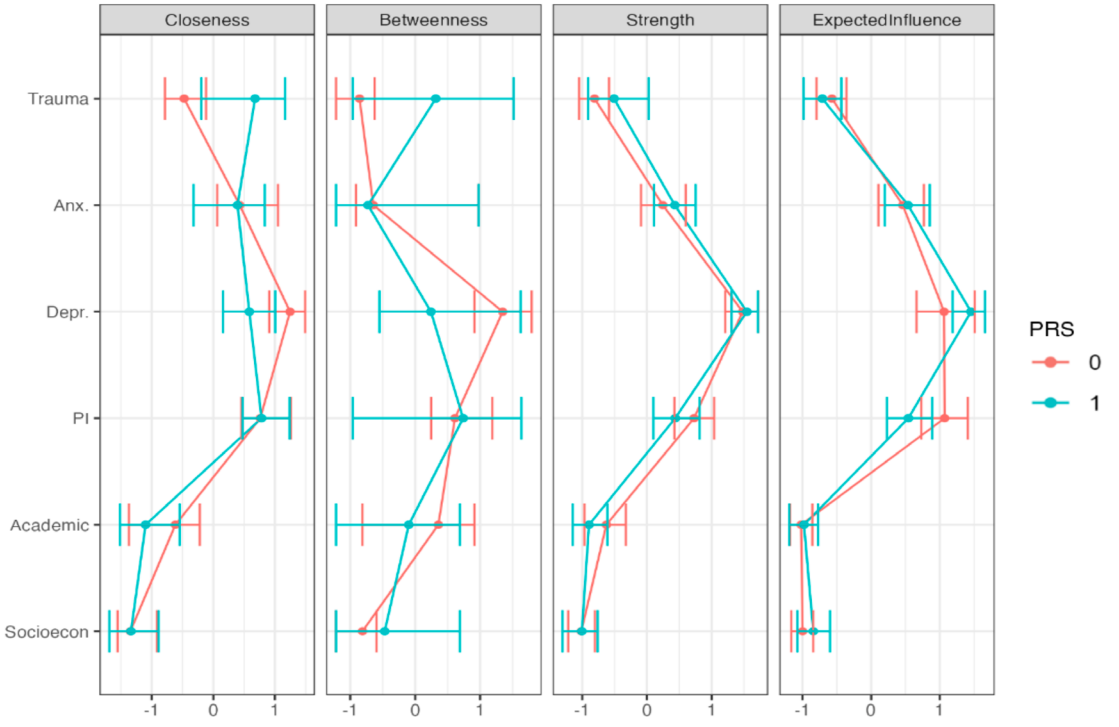
PRS Split Networks: Left Comprising Only PRS-Risk Participants and Right Comprising Only PRS-No Risk Participants



Note. PRS: Psychosis Risk Score; PRS-Risk: adolescents with algorithm scores = 1 or 2, moderate or high risk; PRS-No Risk: adolescents with algorithm score = 0, *low/no risk*); Soc: Socioeconomic status; Acad: Academic performance; PI = Psychological Inflexibility; Anx: Anxiety; Depr: Depression.

Figure 4

PRS Split Network Centrality Indexes



Note. PRS: Psychosis Risk Score; PRS: 0: PRS-No Risk: adolescents with algorithm score = 0, *low/no risk*); PRS: 1: PRS-Risk: adolescents with algorithm scores = 1 or 2, *moderate or high risk;* Socioecon: Socioeconomic status; Academic: Academic performance; PI: Psychological Inflexibility; Anx: Anxiety; Depr: Depression.

robustness and greater uncertainty. Overall, robustness is higher for core psychological variables, while contextual variables show less stable centrality.

Discussion

This study explored how emotional and contextual factors interact in adolescents across different levels of psychosis risk, as measured by the PRS. Using network analysis, we sought to identify key nodes that may sustain or amplify symptom dynamics and to characterize the unique features of youth at subclinical risk of psychosis. To achieve this, we constructed a full network and two subnetworks (PRS-Risk and PRS-No Risk), and approach that, although relatively uncommon in the literature, allows for a direct comparison of psychopathological structures and the identification of specific risk markers (Boldrini et al., 2025). Comparing network architecture across these groups provides novel insights into early vulnerability pathways and highlights potential targets for preventive intervention.

Entire Sample Network

The network estimated from the full sample confirmed the presence of a tightly connected cluster of emotional variables —PI, Depression and Anxiety—, while contextual factors remained comparatively peripheral—echoing recent findings regarding their lower predictive value for psychosis risk (Fernández et al., 2024). Although PRS did not emerge as a highly central variable, its direct links to both emotional and contextual domains suggest a bridging role consistent with dimensional models of early psychosis vulnerability.

Trauma, initially conceptualized as a contextual variable, showed stronger associations with emotional symptoms than with other contextual nodes, its most prominent connection being with PI. Despite its peripheral position in centrality metrics, trauma's associative profile indicates functional embedding within the emotional domain, aligning with models that emphasize its contribution to emotional dysregulation and psychopathological vulnerability (Fusar-Poli et al., 2017; Hardy, 2017).

PI stood out as the most central and influential node, reinforcing its potential role as a transdiagnostic mechanism amplifying the impact of emotional distress and contextual stressors, although its conceptual and psychometric status remains debated (McLoughlin & Roche, 2023; Ong et al., 2019).

From a network theory perspective, PRS—despite its low centrality—may act as an integrative hub linking otherwise distant components, cross-domain activation and feedback loops that increase vulnerability (Borsboom, 2017; Robinaugh et al., 2019). These findings underscore the importance of targeting not only highly central nodes, but also strategically positioned ones in early intervention efforts.

PRS-Risk vs. No Risk Networks

Before comparing network structures between PRS subgroups, it is important to contextualize the proportion of adolescents classified as PRS-Risk by the algorithm. Although these rates may initially appear elevated, the proportion of high-risk adolescents in our sample (3.8%) is consistent with population-based estimates, including the 0.9–8% range reported by Cannon and Kelleher (2016) in non–help-seeking adolescents, depending on the specific criteria applied. Likewise, the percentage of adolescents identified as moderate risk (25.3%) aligns with rates described in recent meta-analyses of CHR-P populations (Catalan et al., 2020; Fusar-Poli et al., 2020). Together, these convergent findings support the plausibility of the risk distribution yielded by PRS and provide a solid foundation for interpreting group differences in network structure.

A key objective of this study was to identify distinct network features in adolescents with subclinical psychosis risk. While both PRS-based networks showed selectively connected structures, the PRS-Risk network exhibited a more integrative configuration, with trauma bridging emotional and contextual domains. Such cross-domain embedding may signal increased vulnerability, as bridging nodes can facilitate the spread of activation across otherwise separate symptom systems (Robinaugh et al., 2019). Boldrini et al. (2025) recently also applied network analysis to psychosis risk using a different design. While their study focused on clinically identified CHR-P adolescents, our study examined emotional and contextual networks across PRS-defined subclinical risk levels in a large community sample. Although both studies compared subgroup networks, our approach places greater emphasis on dimensional and transdiagnostic processes.

One of the most salient distinctions involved the role of trauma. In the PRS-Risk network, trauma was connected to both emotional (PI, Anxiety) and contextual (academic performance) nodes, suggesting a cross-domain bridging role. This contrasts with the PRS-No Risk network, where trauma was only linked to emotional symptoms. This difference echoes the structure observed in the overall sample and aligns with previous literature proposing that trauma fosters psychosis risk through its enduring impact on emotional dysregulation (Hardy, 2017; Isvoranu et al., 2017).

In terms of node centrality, PI remained consistently central across both networks, underscoring its structural relevance as a transdiagnostic feature. In contrast, Depression emerged as particularly prominent in the PRS-Risk network, suggesting its potential role in amplifying emotional distress and reinforcing symptom loops among adolescents at elevated risk. This finding aligns with recent work highlighting depressed mood as a possible transdiagnostic factor across emotional and psychotic disorders (Mavindidze et al., 2025). Similarly, evidence linking daily affective states to psychotic experiences (Senín-Calderón et al., 2016; van der Tuin et al., 2024) reinforces the relevance of affective processes in early psychosis vulnerability – particularly among individuals at ultra-high risk– and underscores the need for early interventions fostering positive affect. At the same time, the prominent role of Depression may also partly reflect the influence of broader contextual or environmental stressors not directly captured in the present network, such as interpersonal adversity or other psychosocial burdens. This possibility may help explain its strong integrative position and highlights the need for future research incorporating a wider range of contextual variables.

The network configuration also supports previous findings by our group (Fernández et al., 2025), which identified PI as a mediator between psychotic-like experiences and emotional symptoms in adolescents. PI's transdiagnostic centrality may reflect how avoidant coping strategies intensify or maintain Anxiety and Depression, and vice versa (Hardy, 2017; Núñez et al., 2021). Network theory highlights this potential for bidirectional loops between symptoms,

reinforcing the importance of early interventions targeting PI and promoting more adaptive, non-avoidant coping mechanisms. This interpretation is consistent with cognitive models of psychosis (Garety et al., 2001), which emphasize the role of appraisal and coping in the development and persistence of psychotic experiences.

Although Anxiety showed moderate centrality in both subgroups, it did not emerge as a structurally dominant node. Instead, its influence appeared secondary to that of PI and Depression, particularly in the PRS-Risk group. This nuanced pattern may help clarify inconsistent findings regarding the role of affective symptoms in psychosis vulnerability (Fusar-Poli et al., 2012).

Overall, these findings underscore the heightened structural integration of trauma and emotional symptoms in adolescents at psychosis risk, while also reinforcing the consistently central role of PI across groups. Together, they highlight the relevance of emotional processes in early vulnerability and the need to address trauma and coping patterns in preventive interventions.

Limitations and Future Direction

Several limitations should be considered. First, the clinical and sociodemographic measures were self-reported, which may introduce bias. The use of infrequency scales helped to reduce this risk, but it cannot be dismissed. Second, the sample was obtained from a general adolescent population using stratified cluster random sampling. Although this approach strengthens representativeness, it may still limit the generalizability of the findings, particularly in comparison with risk samples recruited from clinical settings. In addition, the sample came from two neighboring regions, which may further restrict the reach of the results. Even with stratified random sampling, this may limit the reach of the findings. Third, the cross-sectional design prevents causal interpretation of the associations identified in the network. Longitudinal studies are needed to examine how symptoms evolve over time and whether certain nodes drive clinical trajectories.

Since the aim of this study was to examine the interaction between emotional and contextual factors and their link to subclinical psychosis risk, positive and negative symptoms were not included as individual nodes. These dimensions were already represented in the PRS algorithm through the PQ-B and the *Oviedo Schizotypy Assessment Questionnaire-Abbreviated* (ESQUIZO-Q-A; Fonseca-Pedrero et al., 2010a, 2012). Including them again as separate nodes would have introduced redundancy and could have affected network stability. At the same time, this composite approach may have limited the possibility of examining how specific psychotic-like symptoms relate individually to emotional and contextual variables. Previous research suggests that trauma may show particularly strong associations with specific symptom dimensions, especially positive symptoms such as paranoia (Hardy, 2017; Isvoranu et al., 2017). Therefore, while the PRS offers a parsimonious and scalable dimensional framework, future studies may benefit from combining this broader approach with more fine-grained symptom-level analyses, in line with previous research on psychosis proneness based exclusively on the schizotypy construct (i.e., Fonseca-Pedrero et al., 2010b).

Although network analysis offers a solid framework for mapping symptom interactions, its outputs require caution. There is still no international consensus on how to determine which symptoms are most relevant within these models, and central nodes are not always the best clinical targets (Roefs et al., 2022). Clinical judgment should guide any attempt to translate centrality metrics into therapeutic goals.

Network metrics mainly capture structural associations and may overlook qualitative or phenomenological aspects of lived experience. This highlights the need to integrate phenomenological or idiographic approaches that can place statistical patterns within individual contexts (Fonseca-Pedrero, 2018; Pérez-Álvarez & García-Montes, 2018). Future work should explore hybrid methods combining network analysis with person-centered frameworks to increase both explanatory depth and practical usefulness (Bringmann et al., 2019; Nelson et al., 2021). Such integration may help identify not only structurally central nodes but targets that align with patient experience and clinical priorities.

As network methodologies continue to evolve, further work is needed to assess the robustness and replicability of network estimates.

Conclusion

This study suggests that psychosis risk, as indexed by the PRS, reflects a dynamic network of selectively interacting variables rather than a unified syndrome (Fried, 2022). In adolescents with elevated PRS scores, the central roles of PI and Depression point to increased vulnerability and the potential for escalating psychopathology, while reinforcing affective and regulatory processes as relevant transdiagnostic targets for early intervention within early psychosis pathways (Galderisi et al., 2014; Rigby & McCabe, 2021). While trauma did not emerge as a central node, its bridging connections between emotional and contextual domains align with affective models of psychosis, where emotional distress following trauma contributes indirectly to symptom development.

These findings highlight the importance of early, targeted strategies—particularly those addressing PI and trauma—to reduce risk and disrupt maladaptive symptom dynamics. School-based screening, psychoeducation for families and educators, and timely emotional support may prove especially valuable. Network-informed approaches that target both central and bridging nodes offer promising avenues for improving outcomes in at-risk adolescents.

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Informed Consent Statement: Adolescents or parents were informed in writing and orally regarding the voluntary nature of their participation and the confidentiality of their answers. No compensation was given for participating in the study.

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