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Karimzadeh Shahry, Atena

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Atena Karimzadeh Shahry

Student ID: 4238958

Supervisor: Carlotta L. Rieble

July 2025
Master Thesis Clinical Psychology

Faculty of Social and Behavioural Sciences
Leiden University

Abstract

Suicidal ideation has different risk and protective factors, which might vary by gender – but these have been mostly studied in isolation. The present study examines the relationship between social support, childhood trauma, lifetime adversity, perceived discrimination and suicidal ideation among a non-clinical sample of university students in the Netherlands. Regularized partial correlation networks were estimated, and a Network Comparison Test (NCT) was conducted to explore if the overall network structure differed by gender. In women's network, lifetime adversity showed a positive, direct association with suicidal ideation, while social support demonstrated a negative one. In men's network, childhood trauma appeared to have a positive, direct relationship with suicidal ideation. Initial results indicated some gender differences; e.g. in the network visualisations, the direct, negative edge between social support and suicidal ideation was only apparent in women's network. However, the NCT did not detect statistically significant differences in overall network structure between genders, indicating that gender-specific findings should be cautiously approached and seen as hypothesis-generating. Given the gender imbalance of the cross-sectional sample in the current study, further research using a balanced, longitudinal sample is needed. Such research may then help identify the high-risk groups and support the development of more gender-sensitive, targeted suicide prevention strategies.

Layman's Abstract

This study explored how perceived discrimination, lifetime adversity, childhood trauma, social support, and suicidal ideation are related and whether this is different for men and women university students. Suicidal ideation refers to thoughts centred around one's own death. It can be active (when someone is actively thinking or planning to end their own life) or passive (when someone is wishing their own death, without an active plan). In the current study, we examined both types of suicidal ideation. For this, a statistical approach called network analysis was used to examine how these factors are statistically connected.

The study identified several factors that were closely related to suicidal ideation in students. At first look, it seemed like there were gender differences. For example, women who reported having more social support also on average reported lower suicidal ideation, but for men, we did not find this pattern. However, the statistical network comparison test was not significant, which means that no conclusion can be drawn from these apparent differences. Nevertheless, our study may inform future research, which could help develop prevention strategies. Overall, our findings highlight the importance of considering both personal histories and social environments in understanding suicidal ideation.

A Network Analysis of Gendered Risk Factors for Suicidal Ideation: Insights from a University Student Sample

Suicide is a leading cause of death in the world that has severe personal, social, and economic consequences. It claims more than 720,000 lives annually, and it is the third leading cause of death among young people aged 15 to 29 (WHO, 2024). Suicide does not only lead to a tragic loss: it results in a significant emotional burden to the family and friends, and it sometimes poses a danger to the mental health of bereaved people (Bartik et al., 2013; Pitman et al., 2014; Pitman et al., 2016). Besides the the sorrow it brings, it also has high financial costs: suicide and non-fatal self-harm have been estimated to cost $510 billion in the United States annually (Peterson et al., 2024). Given the high prevalence, devastating emotional effects, and economic burden, having well-designed suicide prevention strategies is crucial. While suicide is a major global concern for people of all ages, university students are especially vulnerable. In fact, research shows that the prevalence of suicide among them is higher than the general population (Sivertsen et al., 2019). Therefore, in the present study, we focused on this sample to gain insights on certain potential risk factors for suicide.

Studying suicide among university students presents several important challenges. While it is theoretically possible to examine suicide attempts in non-clinical populations such as university students, doing so is difficult due to the low base rate of such events. It limits the power of conventional statistical methods. A more feasible alternative is to focus on suicidal ideation, which is more commonly observed in non-clinical student populations, and is highly relevant. As Harmer et al. mention (2022), one of the early warnings that can be used to intervene and prevent a suicide attempt is known to be suicidal ideation. In 2013, the American Substance Abuse and Mental Health Services Administration (SAMHSA) reported that approximately 13% of individuals who experienced suicidal ideation in the past year made a suicide attempt during that same year (SAMHSA, 2013).

The ICD-11 (2020) describes suicidal ideation as “thoughts, ideas, or ruminations about the possibility of ending one's life, ranging from thinking that one would be better off dead to the formulation of elaborate plans.” It can be passive when it involves the thought of death without an intention to commit suicide (e.g., “I wish I was dead”) and active when it involves active thought and intention of committing suicide. In the present study, we focused on suicidal ideation in the past year.

The prevalence of suicide ideation among university students makes them a priority for focused research and targeted suicide prevention strategies (De Oliveira Crispim et al., 2021). However, despite the urgent need for suicide prevention, identifying individuals at the greatest risk remains a significant challenge. The vast number of potential risk factors, ranging from demographic and psychological characteristics to social influences, makes it difficult to develop a comprehensive model that captures all key elements (Fortune & Hetrick, 2022). Moreover, some studies suggest that gender differences may play a role in these risk factors, further complicating efforts to construct a unified and coherent model of suicidal ideation (E.g., Um et al., 2020; De Graaf et al.; 2006).

Effective prevention requires a thorough understanding of suicide, including the complex interplay of factors contributing to suicidal thoughts. To develop more comprehensive interventions, it is crucial to examine a broad range of risk factors. Among all the variables that can be influential in suicidal ideation, this study examines childhood trauma, lifetime trauma, perceived discrimination, and social support. Various studies have explored these factors (Kohlbrenner et al., 2016), and the following section outlines their relevance to the current study.

Risk and Protective Factors

Lifetime Adversity

According to the Diagnostic and Statistical Manual of Mental Disorders, 5th Edition (DSM-5), trauma is defined as exposure to "actual or threatened death, serious injury, or sexual violence" (American Psychiatric Association [APA], 2013, p. 271). In the present study, participants were asked whether they had experienced such "traumatic events," including, for example, sexual violence or serious injury. This type of exposure was referred to as "lifetime adversity" throughout the study.

Adversity over the life course is a concept whose relationship with suicidal ideation has been widely studied across different contexts and different populations (Buckley et al., 2024). Although suicidal ideation and self-injurious thoughts are positively connected with Posttraumatic Stress Disorder (PTSD) the impact of traumatic events on suicidal ideation is not limited to those who suffer from this mental disorder (Spitzer et al., 2020; Gradus et al., 2010; Ramsawh et al.,2014). Different types of lifetime trauma have been looked into, and although there can be variances in the relationship between each subcategory of trauma and suicide, the concept has been shown to be associated with higher levels of suicidal ideation (Ásgeirsdóttir et al., 2018; Liu & Miller, 2014; Graziano et al., 2021; Spitzer et al., 2020; Simons et al., 2019; Um et al., 2020). However, there seems to be a difference in the impact

of different categories of lifetime trauma across different genders. For example, non-interpersonal trauma, which is a traumatic event not directly caused by another person, might be a predictor of suicidal ideation in men only (Ásgeirsdóttir et al., 2018; Séguin et al., 2021). Given the existing variations in findings, the present study focused on gender differences in the relationship between lifetime adversity and suicidal ideation.

Childhood Trauma

Childhood trauma is another critical factor related to suicide, as early experiences of emotional and physical abuse can have long-lasting effects and heighten the risk of suicide attempts (Zatti et al., 2017). Examining this relationship through the interpersonal theory of suicide reveals that emotional abuse may have an indirect positive relationship with suicidal ideation via perceived burdensomeness (Schönfelder et al., 2021b). In an indirect relationship, childhood trauma fosters apathy and reduces an individual's ability to express emotional behaviour, leading to increased loneliness and diminished social support, which in turn exacerbates suicidal ideation (Wang et al., 2021). Furthermore, childhood trauma has been shown to have a positive relationship with suicide and suicidal ideation in veterans (Simons et al., 2019).

Regarding the role of gender in the relationship between childhood trauma and suicide, there are some evidence suggesting the gender difference in the relationship. For example, Ásgeirsdóttir et al. (2018) found that sexual trauma and childhood trauma have a stronger connection with suicidal ideation in men. This difference highlights the need for further studies that explore the gender-specific impacts of childhood trauma on suicide risk.

Perceived Discrimination

Discrimination refers to treating someone unfairly or differently, often more negatively, based on characteristics such as their race, gender, or sexual orientation (Cambridge University Press, n.d.). Regardless of its reason, discrimination can be an important risk factor for both suicidal ideation and suicide attempts (Kohlbrenner et al., 2016; Um et al., 2020; Wang et al., 2018). One way in which it can contribute to suicidal ideation is via perceived burdensomeness in the frame work of Interpersonal Theory of Suicide. (Kwan et al., 2023).

Although there have been a considerable number of studies on the relationship between perceived discrimination and suicide, there are not many that investigated gender differences in this relationship. De Graaf et al. (2006) have found a gender difference in the relationship between perceived discrimination and suicidal ideation among homosexual men and women, as the positive association between suicidal ideation and perceived

discrimination was only apparent in men's sample. The present study focused on addressing the research gap regarding gender differences in the relationship.

Social Support

Social support is widely recognized as an important protective factor against psychological challenges (Gariépy et al., 2016; Y. Wang et al., 2021; Bedaso et al., 2021). Consistent with this, a meta-analysis of 118 studies highlights its significant role in reducing suicidal ideation (Darvishi et al., 2024). In a similar vein, a network analysis study on war veterans with PTSD found that social support was a protective factor against suicidal ideation and suicide risk (Graziano et al., 2021). Furthermore, a nine-year longitudinal study on suicidal ideation among veterans found that larger social networks and higher perceived social support were linked to lower chronicity and severity of suicidal ideation (Arenson et al., 2021).

However, the protective role of social support is not entirely consistent across genders. Manning et al. (2020) found that in people with late-life depression, social support did not function as a protective factor in men. Similarly, Um et al. (2020) examined suicidal ideation among North Korean refugees and found that while having a trustworthy, supportive church was a protective factor for women, it was a risk factor for men. These findings suggest that the effectiveness of social support in mitigating suicide risk may be influenced by gender and needs further investigation.

Challenges in Understanding Suicide Risk Factors

While the exploration of various suicidal ideation risk factors has provided valuable insights, a broader understanding of these factors remains incomplete. A meta-analysis examining 365 studies on risk factors for suicide and suicidal ideation found many factors. Still, it came to the conclusion that our ability to predict suicidal ideation based on these factors is only slightly better than chance (Franklin et al., 2016). The article suggests that the lack of research into how multiple risk factors interact may be a major reason for the limited progress in this area. While suicidality results from a complex interplay of psychological, social, and environmental factors (Steele et al., 2017), most studies focus on these risk factors in isolation (Masango et al., 2008; Favril et al., 2022). This approach ignores the fact that some of the factors could mitigate or amplify the effect of others. Given these challenges, there is a need for methodologies that can better capture the complex relationship between variables that contribute to suicide attempts. The following section introduces network analysis as an approach useful for addressing this gap.

Network Analysis

To better understand how risk factors contribute to suicidal ideation, we used network analysis. In recent years, network analysis gained popularity for allowing researcher to explore relationships and interactions between variables in an interconnected system (Fried & Cramer, 2017; Robinaugh et al., 2020). Network analysis models the variables as a network. It represents them as nodes (e.g., childhood trauma, perceived discrimination) and their associations as edges, where the strength of these edges reflect the magnitude of the relationships between variables. It allows for the identification of central factors that may play a critical role in maintaining or influencing a network, and can help shaping a deeper understanding of the contribution each factor makes while accounting for the others. (Borsboom & Cramer, 2013)

This study aims to enhance understanding of how risk and protective factors are interconnected in relation to suicidal ideation among university students, with particular attention to potential gender differences in these patterns. In order to reach this goal, we estimated a network for suicidal ideation that includes all the aforementioned nodes as risk and protective factors for men and women. Based on hypotheses derived from previous literature, this study set out to answer three main questions (Nock et al., 2008; Schönfelder et al., 2021; Liu & Miller, 2014; Dillon et al., 2020; Darvishi et al., 2024; Graziano et al., 2021; Ásgeirsdóttir et al., 2018; Um et al., 2020; Manning et al., 2020; Cui et al., 2022). It tested whether higher levels of childhood trauma, lifetime trauma, and perceived discrimination were positively associated with suicidal ideation in university students, and whether higher levels of perceived social support were negatively associated with suicide attempts. Lastly, it tested the hypothesis that the network structure and the strength of associations between these factors vary between men and women university students. By mapping the interconnected relationships between risk and protective factors, this research hopes to provide more information about the population at risk of suicidal ideation among university students.

Research Methods

Design and Procedure

This research is a subproject and a part of the larger WARN-D (Building an Early Warning System for Depression) project that is still ongoing. (Fried et al., 2023) WARN-D is a multi-stage project that examines around 2000 students from vocational schools and technical/research universities in the Netherlands and follows them for two years. It aims to build a personalized early warning system for depression. It is a multi-cohort study with four

cohorts, each with approximately 500 students involved. This thesis uses the baseline data collected from cohorts 1 and 2.

The study was advertised both online and offline in partnership with several universities to reach students effectively. Interested students provided informed consent and were screened for eligibility based on the study's inclusion and exclusion criteria in an online survey. In Stage 1, eligible students completed a 75-minute online survey assessing various risk factors for depression. Upon completion, they received €7.50. For further information on the WARN-D project, please refer to the references section (Fried et al., 2023). All study materials were available in English and Dutch.

Participants

Participants in this study had to be enrolled at a vocational school, technical university, or research university in the Netherlands, older than 18, fluent in reading English or Dutch, and have a European bank account as well as a smartphone that runs on Android or IOS. The exclusion criteria included having at least moderate depression, experiencing mania or thought disorders, having a substance use disorder, being in or waiting for treatment for any of these, exhibiting moderate to severe suicidal ideation, or expressing that using a smartwatch would cause significant stress. (Fried et al., 2023). The sample size of this study consisted of 606 people in the first stage, with 96 men (15.8%), 487 women (80.4%), and the remaining 3.8% identifying as non-binary or preferring not to disclose their gender. Participants' age ranged from 18 to 61 (M = 22.61, SD = 4.02).

Measures

The WARN-D study used self-report measures during its baseline (Fried et al., 2022). For the study to be implemented, a combination of validated and modified scales, and items created especially for the study were used. Adaptations were guided by principles such as minimizing changes to maintain the validity of the measures, reducing participant burden, and ensuring cultural relevance for a student population in the Netherlands (Fried et al., 2023).

It is worth noting that the measures and research procedures slightly deviated from the pre-registered plan due to certain challenges. Further details regarding these procedural changes can be found in Appendix A. The questionnaires used in the study are provided in Appendix B.

Suicidal Ideation in the Past Year

The question regarding suicidal ideation was adapted from the Columbia Suicide Severity Rating Scale (Posner et al., 2011). A one-item question measured the history of active/passive suicidal ideation in the past year. ("About how many months in the last 12 months did you

wish you were dead, wish you would go to sleep and never wake up, or have thoughts of killing yourself?"). People could answer between 0 and 12 months.

Lifetime Adversity

Questions regarding lifetime adversity were adapted from the Life Events Checklist for DSM-5 (LEC-5) and implemented in the first stage of the study (Gray et al., 2004). The LEC-5 demonstrates adequate test–retest reliability (r = .82; mean κ = .61), strong convergent validity with the TLEQ (r = −.55), and significant associations with PTSD symptom severity (r = .34 to .48).

In this questionnaire, people were given a list of 14 traumatic life events, such as natural disasters or sexual harassment, and they were asked if they had ever encountered such an event or "Any other very stressful event or experience". Then they were asked to specify whether it had happened to them, if they had only witnessed it, or if the question did not apply. The checklist for DSM-5 has been adapted for WARN-D, and the items "combat or exposure to a war zone" and "captivity (e.g., being kidnapped, abducted, held hostage, prisoner of war)" were removed to minimise irrelevant items. The composite score ranges from 0, the lowest trauma experienced, to 15, the highest. It is worth noting that in the second cohort, the phrasing of the Dutch version of the main question changed slightly. More information about changes can be found in the codebook (https://osf.io/xqn3a).

Childhood Trauma

Childhood trauma was measured through the 5-item version of the Childhood Trauma Questionnaire Short Form (CTQ-SF) during the first stage (Grabe et al., 2012). It asked five questions about the participants' childhood and teenage years including sexual, physical, and emotional trauma, and neglect (Cronbach's α: 0.757). Each item (e.g., someone in my family hated me) was answered on a 5-point Likert scale, ranging from 1, never true, to 5, very often true. Then, the composite score for childhood trauma was calculated, ranging from 5, the lowest trauma experienced, to 25, the highest.

Perceived Discrimination

Perceived discrimination was operationalized using the Williams Everyday Discrimination Scale (Williams et al., 1997). In this questionnaire, people were asked how often they were discriminated against because of their race, ethnicity, gender, sexual orientation, religion, physical appearance, or other characteristics (Cronbach's α: .88). They were asked to answer this question in nine different domains and on a 6-point Likert scale. For example, "You are treated with less respect than other people are". Each item was answered on a 6-point Likert scale, in which people indicated the frequency, with 1 being "never" and 6 being "almost

every day". Then, the Composite Score Discrimination was calculated, ranging from 9, the lowest perceived discrimination, to 54, the highest. It is worth noting that in the second cohort, the phrasing of the Dutch version of 3 questions changed slightly. More information about changes can be found in the codebook. The materials are available on the Open Science Framework (https://osf.io/xqn3a).

Social Support

The questions regarding social support were adapted from Caring Universities (n.d.), which was based on the Supportive and Negative Social Interaction Scale (SIS; Schuster et al., 1990). This variable is assessed using a five-question questionnaire, with each question measuring a different subconstruct (e.g., feeling loved by others). Each subconstruct is captured by a single question, such as, *"How much do the people in your personal life understand the way you feel about things?"* People answered on a 5-point Likert scale, with 1 being never/not at all and 5 being extremely/very often. Then, a composite score was calculated, from 5 to 25, in which a higher number meant better social support.

Ethics

The data collection for the WARN-D project received approval from the Leiden University Research Ethics Committee (2021-09-06, E.I. Fried-V2-3406). Furthermore, the study was exempted from requiring additional ethics approval under the Medical Research Involving Human Subjects Act (Fried et al., 2023).

Statistical Analysis

A network analysis approach was employed to investigate the relationship between suicidal ideation, lifetime adversity, childhood trauma, perceived discrimination, and social support. All statistical analyses were conducted using JASP, an open-source software for easy and reproducible statistical analysis (JASP Team, 2023, Version 0.19.3). The distribution of the variables and descriptive statistics were calculated using this software.

Several steps were taken in the analysis process. Firstly, all data were prepared for analysis by calculating the scales' sum scores after any required items had been reverse-scored. Second, all continuous variables (e.g., childhood trauma, lifetime adversity, perceived discrimination, and social support) were standardized using z-score transformation to ensure comparability across different measurement scales. Missing data were deleted listwise (n = 2 in gender). Additionally, individuals who identified as non-binary were excluded from the analysis due to the specific focus of the research question (n = 23).

Power Analysis

We determined the maximum number of nodes that may be included in a network with the available sample size in order to maintain sufficient power in the network studies. To ensure sufficient statistical power, it is recommended as a rule of thumb that the sample size should be at least five times the number of parameters. Since we planned to estimate the network separately for men and women, we needed to do our calculations considering the group with the smaller number of participants, namely men. The number of parameters was calculated based on the formula (a* (a-1)/2), where a represents the number of nodes (Epskamp & Fried, 2018). Given a dataset with 96 male participants, a network with up to 5 nodes could be reliably estimated.

Network Analysis

The network structure was estimated using a Gaussian Graphical Model (GGM) with edges representing partial correlations, implemented through the mgm package in JASP (Epskamp & Fried, 2018; Haslbeck & Waldorp, 2020). To reduce weak or spurious relationships (Epskamp et al., 2017), the networks were regularized using Extended Bayesian Information Criterion Graphical Lasso (EBICglasso) method and the tuning parameter was set to zero. The Extended Bayesian Information Criterion (EBIC) is a model selection tool used in Gaussian graphical models. When combined with the graphical lasso (EBICglasso), it helps to identify sparse and accurate network structures by optimizing the regularization parameter selection (Foygel & Drton, 2010).

To evaluate the significance and influence of each node within the network, three centrality indices were computed: strength, closeness, and betweenness. Strength centrality is determined by summing the absolute weights of all edges connected to a node, and it represents the extent to which a node directly impacts or is impacted by others. Closeness centrality is derived from the inverse of the total shortest path distances between a given node and all other nodes, and it shows how integrated a node is within the network, and how rapidly it can be influenced by shifts in other nodes. Betweenness centrality quantifies the extent to which a node lies along the shortest paths between other nodes (Bringmann et al., 2019; Epskamp et al., 2017).

In addition, the estimated network needs to be accurate and stable. Network accuracy refers how precisely the edges estimate the associations among variables in the sample (Epskamp et al., 2017b). Network stability, on the other hand, is the robustness of the network characteristics (e.g., edge weights or centrality measures) when it is subjected to

variations in the data (Borsboom et al., 2021). Bootstrapping is a method commonly employed to check for the accuracy and stability of the estimated networks. Nonparametric bootstrap, as one type of bootstrapping, involves drawing samples with replacement from the original dataset to create numerous "bootstrapped" samples. Variability and confidence of network parameters can be evaluated by estimating the networks on each of these samples. This type is widely used for evaluating the accuracy of the estimated networks. In the current study, accuracy of the network edges was assessed using nonparametric bootstrapping procedures with 1,000 iterations. The case-dropping bootstrap, another widely used resampling method, repeatedly re-estimates the network after random removal of portions of the data to assess the stability of network characteristics. The stability of centrality indices was assessed performing case-dropping bootstrapping with 1,000 iterations, following the guidelines of Epskamp and colleagues (2018). This stability analysis ensures that the ranking of centrality indices, expressed as standardized z-scores, remains consistent even when the model is estimated with a reduced sample size. Moreover, to further examine whether the observed differences in edge weights were statistically significant, we conducted a bootstrapped edge weight difference test separately for the male and female networks.

To compare the networks of men and women, the Network Comparison Test package was used in R (van Borkulo et al., 2017). The Network Comparison Test (NCT) is a permutation-based statistical method used to examine differences between networks across various structural properties. This study employed three primary tests within the NCT framework: the network invariance test, which assesses whether the overall structure of two networks differs; the global strength invariance test, which evaluates differences in the total connectivity within each network; and the edge invariance test, which investigates whether specific connections between nodes vary when a significant structural difference is detected between networks. According to the guidelines, the edge invariance test may be done only if the overall structure of the two networks are different (van Borkulo et al., 2023).

Results

Prior to conducting the analysis, it was hypothesised that higher levels of childhood trauma, perceived discrimination, and lifetime adversity would be associated with higher levels of suicidal ideation, while social support would show a direct negative association with suicidal ideation. It was also hypothesised that the overall network structures would differ between men and women.

Descriptive Statistics

For detailed demographic characteristics of the sample, see Table C1 in the Appendix. Tests of normality indicated that the variables did not follow a normal distribution (see Appendix Table C2). Therefore, Spearman's rho, a non-parametric test, was used to calculate the correlation coefficients between the variables. Descriptive statistics, together with the abbreviations of variables used in network visualizations and the results of zero-order Spearman's correlation analyses, are presented in Table 1. As shown in the table, all variables were significantly correlated with each other at the $p < .001$ level. All the correlations were in the expected directions (i.e., positive or negative as hypothesized).

Table 1

Descriptive Statistics and Pearson's Correlation

Node Name	N	Range	Mode	Mean	SD	PD	SS	CTQ	LA	SI
PD	583	9-54	9	14.6	6.0	-	-	-	-	-
SS	583	5-25	19	18.7	2.8	-0.25 < .001	-	-	-	-
CTQ	583	5-25	5	7.4	2.7	0.25 < .001	-0.34 < .001	-	-	-
LA	583	0-15	3	3.4	2.6	0.295 < .001	-0.12 .003	0.26 < .001	-	-
SI	583	0.000	0	0.6	1.9	0.159 < .001	-0.20 < .001	0.19 < .001	0.18 < .001	-

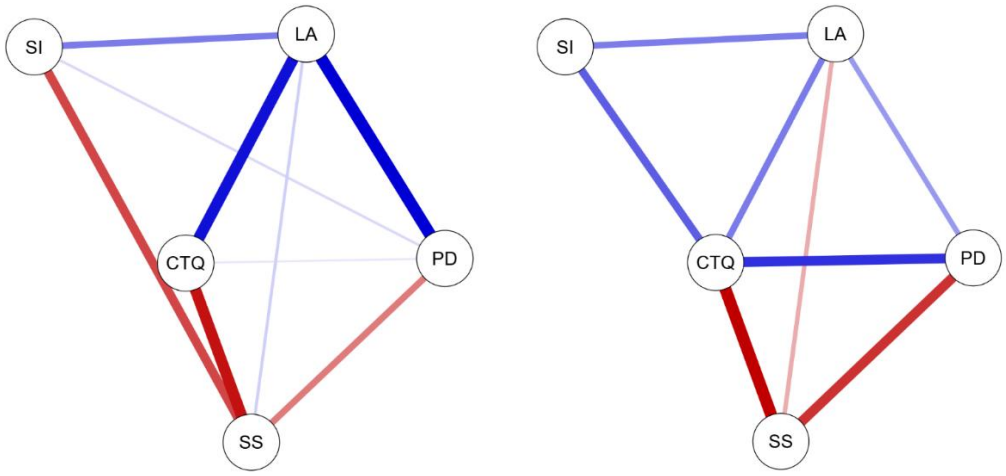
Note. PD = Perceived Discrimination; SS = Social Support; CTQ = Childhood Trauma; LA = Lifetime Adversity; SI = Suicidal Ideation.

Network Estimation

The networks for men and women are shown in Figure 1. The number of non-zero edges were 8/10 for men and 9/10 for women.

Figure 1

Network Visualizations for Women (Left) and Men (Right)



Note. Edges represent partial correlations. The colour red indicates negative correlation, while blue means positive. Edge thickness and saturation indicate magnitude of the regularized partial correlation (Epskamp et al., 2012). The tuning parameter was set to zero. Nodes represent suicidal ideation (SI), Lifetime Adversity (LA), Childhood Trauma (CTQ), perceived discrimination (PD), and social support (SS).

As expected, most edges were positive. The strongest edge weight in women's network was between lifetime adversity and perceived discrimination (0.29). The strongest negative edge weight in the network was between childhood trauma and social support (- 0.27). In the men's network, the strongest edge weight was between childhood trauma and social support (-0.28). The strongest positive edge weight was between perceived discrimination and childhood trauma (0.23). Although these are the strongest edge weights observed in each network, the correlations between all the variables are considered weak (Taylor, 1990). In men's network, suicidal ideation had the strongest edge weight with lifetime adversity and childhood trauma, with the highest edge weight for childhood trauma followed by lifetime adversity. However, according to the bootstrapped edge weight difference test, none of these edges are significantly different from near-zero edges. In the women's network, the strongest edge weight involving suicidal ideation was a negative association with social support, followed by the edge with lifetime adversity. The specific edge weight of each construct can

be observed in Appendix Table C3 and the heatmap of bootstrapped edge weight difference test can be found in Appendix Fig. C4 and C5.

Accuracy of the Gendered Networks

To evaluate the accuracy of edge weights, 1,000 iterations of non-parametric bootstrapping were performed. In the nonparametric bootstrap procedure used to assess network accuracy, the mean of the resampled networks showed a reasonable correlation with the original network results. However, the 95% confidence intervals for some edges were notably large, particularly in the men's network, which indicates that results should be interpreted with caution. The outcomes of the non-parametric bootstrapping are presented in Appendix Figure C6.

Centrality Indices and their Stability

The relevance of nodes in a network can be assessed using centrality indices. Centrality measures were calculated for both networks. However, since neither showed stable estimates, no interpretation or conclusions were drawn, and the centrality measures are presented in Fig. C7 in the appendix. Case-dropping bootstrapping was conducted to assess the stability of centrality indices in both networks (see Fig. C8 in the Appendix). Using 1,000 iterations, we examined how centrality measures changed as cases were removed. In the men's network, strength centrality remained relatively stable but showed some decline as more cases were dropped, whereas betweenness and closeness centrality exhibited noticeable fluctuations. In contrast, the women's network demonstrated greater stability, with all three centrality indices remaining relatively consistent. However, the wide confidential intervals, particularly in the men's network, suggest that these findings may not be interpreted.

Network Comparison Tests

To investigate the hypothesis that networks differ between men and women, three primary tests within the NCT framework were planned: the network invariance test, the global strength invariance test, and the edge invariance test. The structure invariance test was not statistically significant ($M = 0.208$, $P = .535$). Similarly, no significant difference was found in global strength between the networks ($S = 0.064$, $P = .881$), with group-level global strength of 1.390 for women and 1.455 for men. Since the overall networks were not significantly different from each other to begin with, we did not proceed to interpret the results of the edge invariance test.

Discussion

The present study aimed to investigate whether higher levels of lifetime adversity, childhood trauma, and perceived discrimination are associated with higher levels of suicidal ideation among both genders. In women’s network, the hypothesis was supported for lifetime

adversity and perceived discrimination while in men's network, the hypothesis was supported for lifetime adversity and childhood trauma. Furthermore, it was hypothesised that higher levels of social support is connected to lower levels of suicidal ideation, particularly in women. The hypothesis was supported for women's network. However, men's edge weight matrix did not show any association between social support and suicidal ideation. The third hypothesis in the study was regarding the significant difference between men's and women's network, particularly in the social support edge. However, the Network Comparison Test did not reveal any significant difference between global structures of two networks, preventing us from moving further to specific edge difference test. These hypotheses were informed by previous research identifying childhood trauma, lifetime adversity, and perceived discrimination as risk factors for suicidal ideation (Schönfelder et al., 2021; Liu & Miller, 2014), and highlighting the protective role of social support, especially in women (Darvishi et al., 2024; Graziano et al., 2021). To this end, separate networks were estimated for male and female university students and then compared using the Network Comparison Test (NCT).

In the following sections, the findings of this study will be examined in relation to the hypotheses, as well as in the context of the broader literature on suicidal ideation and its associated risk and protective factors. When interpreting the results, it is important to keep in mind that 1) no significant difference was found between the networks of men and women, despite descriptive differences, and 2) these networks are based on cross-sectional data, meaning causal relationships cannot be inferred from this type of data. Therefore, the term "risk factor" in this study should not be seen to imply causality between variables.

Network for Women

The study's first hypothesis was the existence of positive associations between suicidal ideation and childhood trauma, lifetime adversity, and perceived discrimination. Consistent with the prior research, higher levels of suicidal ideation was associated with higher levels of lifetime adversity, meaning that ,on average, women who reported more exposure to traumatic events were more likely to report having suicidal ideation in the past 12 months.

Although our statistical analyses do not allow us to draw definitive conclusions about the directionality of the associations, given the retrospective, checklist-based nature of the lifetime adversity measure, which captures the occurrence of specific events in the past, it may be more appropriate to interpret the relationship as lifetime adversity influencing suicidal ideation. Since the actual occurrence of traumatic events is unlikely to be shaped by an individual's suicidal ideation, it is reasonable to suggest that exposure to lifetime adversity

and certain traumatic experiences may increase the risk of suicidal ideation, particularly among women. The edge-weight matrix test suggested that, among all variables linked to suicidal ideation, lifetime adversity showed the strongest positive association. This edge was the only positive edge of suicidal ideation that was significantly different with near-zero associations, according to the bootstrapped edge weight difference test (See detailed heat maps in Appendix Figure C4). These findings, as supported by the existing body of literature, further confirm the possibility of considering exposure to traumatic events as a risk factor for suicidal ideation (Yıldız et al., 2022; Howarth et al., 2020; Lin et al., 2022).

Among other associations, childhood trauma did not demonstrate a positive relationship with suicidal ideation. In terms of perceived discrimination, the edge weight was not absolute zero (0.04), however, it showed no significant difference with other zero edges. The possible explanations for the null findings in this study, other than the real absence of the relationships, are further discussed later in the limitation section.

Regarding the second hypothesis, the negative relationship between suicidal ideation and social support, this study contributes further evidence to the existing literature supporting this association. The negative edge between suicidal ideation and social support was the strongest edge within women's network. In other words, women who reported lower levels of social support were more likely to experience suicidal ideation in the past 12 months, and vice versa. Although there is a large body of literature suggesting the protective role of social support against suicidal ideation, the interpretation of the available data must be done with caution. Social support measures, as available in Appendix B, measures whether a person feels socially supported at the moment they are answering the questionnaire, whereas suicidal ideation askes about experiencing the thoughts during the past 12 months. This temporal misalignment complicates drawing definitive conclusions about the implications of the available data. It can be cautiously stated that the findings of this study align with previous research supporting a protective association between social support and suicidal ideation (e.g., Darvishi et al., 2024); however, they are not sufficient on their own to confirm this hypothesis. Moreover, the cross-sectional nature of the data further limits the extent to which these associations can be interpreted.

An additional observation emerged from the network analysis, which, although was not part of the initial hypothesis, presents a notable pattern. In both women's and men's network, higher levels of childhood trauma was shown to be associated with lower levels of social support, with the association being one of the strongest negative associations within both networks. This relationship might be understood in multiple ways: as Berardelli et al.

(2022) and Ahouanse et al. (2022) suggest, individuals who come from families that caused childhood trauma are more likely to lack family social support in adulthood. While part of this negative relationship can be attributed to this argument, Latham-Mintus and Brown (2018) and Huh et al. (2014) propose that childhood trauma affects interpersonal skills, which in turn leads to difficulties in forming supportive relationships later in life. Considering the retrospective, checklist-based nature of the childhood trauma measures, it might be more reasonable to interpret this directionally as trauma affecting social support (Logue et al., 2024; Nickerson et al., 2016), though shared origins (e.g., early family environment) may also underlie both.

Network for Men

The primary hypothesis of this study proposed that suicidal ideation would be positively associated with childhood trauma, lifetime adversity, and perceived discrimination; social support would be negatively associated with suicidal ideation; and that the overall structure of men's network would be different from women's. In the current research, childhood trauma showed the strongest positive association with suicidal ideation in men's network, meaning that men who experienced trauma as children were on average more likely to report having suicidal ideation in the past 12 months as adults. Considering the retrospective, checklist-based nature of the childhood trauma measures, it is logical to interpret this directionally as childhood trauma affecting suicidal ideation, and therefore acting as a risk factor. This finding is in line with the main body of literature which emphasizes the positive relationship between these two (e.g., Miller et al., 2017; Bahk et al., 2017; Zhou et al., 2024). However, although childhood trauma appears to have the strongest edge with suicidal ideation, it does not show any statistically significant difference with almost-zero edges within the network. The same applies for lifetime adversity- suicidal ideation edge. It is the second-strongest edge according to the specific edge weight table. However, it is not significantly different from any of the near-zero edges.

Perceived discrimination- suicidal ideation, although apparent in the network visualization, is an almost-zero edge, according to the specific edge weight table. The contradiction apparent in the network's statistical results might be related to limitations in statistical power due to the lower number of participants and variability in the data, or an actual absence of a significant, positive relationship between suicidal ideation and other variables.

An additional observation emerged from the network analysis, which, although was not part of the initial hypothesis, presents a noteworthy pattern. In male network, childhood trauma showed a significant positive association with perceived discriminationn, meaning that, on average, men university students who report higher levels of childhood trauma also report higher levels of perceived discrimination. A possible explanation is that trauma-exposed individuals may become more sensitive to social cues, leading them to interpret ambiguous interactions as discriminatory or hostile, and to perceive threats or assume negative intentions while having a social interaction (Sandre et al., 2018; McLaughlin et al., 2020; Wang et al., 2021). Another explanation can be that individuals from more traumatic backgrounds are often exposed to systemic disadvantages, like poverty, displacement, or social marginalisation, that increases the risk of early-life trauma (Assari, 2020).

Lastly, the network does not display a direct, negative link from social support to suicidal ideation. In this study, we could not find evidence for the protective role of social support against suicidal ideation in men. However, the results have to be interpreted with caution, considering the power challenges posed by the relatively small sample size in the men's group, which will be discussed further in the next section.

Networks Comparison

The Network Comparison Test (NCT) was conducted to examine potential differences between the men's and women's network. Contrary to our expectations, however, the global network structures did not differ significantly. This outcome, which seems at odds with the visualisation of the networks, raised important considerations. As noted by van Borkulo et al. (2023), non-significant NCT results do not necessarily indicate the absence of true differences between networks, although they might. Several other factors, such as statistical power, may contribute to null findings.

In our case, the pronounced imbalance in sample sizes between the male and female groups (n = 96 vs. n = 487) may have affected the power of the test. Specifically, when one group is at least 1.5 times larger than the other, the power of the NCT is effectively constrained by the size of the smaller sample, in this case, 96 participants. Moreover, it is worth mentioning that the power of the NCT is generally limited when detecting subtle differences, such as a change in a single edge weight (van Borkulo et al., 2023). While initial visual inspections indicated that there is a difference between women's and men's network when it comes to the protective role of social support against suicidal ideation, this was not supported by NCT and did not reach statistical significance within the context of the broader

network comparison. However, having mentioned the limitations of NCT in the current study, more research should be done with larger, more balanced sample, to have a clearer picture of the relationship between these two constructs.

Implications and Recommendations:

From a theoretical perspective, this study adds to the existing literature on the complex relationships between risk and protective factors of suicidal ideation, particularly within a gendered framework. The results of this study suggest allocating more research focus to the interplay between traumatic experiences and suicidal ideation (e.g., childhood trauma in men's network and lifetime adversity in women's). Given the current findings, further research, particularly studies capable of shedding more light on the temporal sequencing among the variables, appears essential (e.g., EMA). Ultimately, achieving a more accurate and documented understanding of the causal relationships between variables is of great importance to develop prevention strategies.

Moreover, the present study added to the existing body of literature suggesting the protective role of social support against suicidal ideation, especially in women. However, the present results did not find statistically significant structural differences between male and female networks, despite the hypothesis we had. This result could be due to the significant difference in sample size between the two groups, or that the structure of the networks was not in fact significantly different. Therefore, future research is encouraged to ensure a more balanced gender distribution in sample design to enhance the reliability and interpretability of comparative findings.

From a practical perspective, although the cross-sectional nature of the data precludes drawing causal or directional conclusions, the observed relationships among some key psychosocial variables may help guide future actions in developing targeted prevention strategies. Some of the variables used in this study, including childhood trauma and life adversity, refer to the individual history of the participants. Although causality cannot be definitively established, it can be cautiously concluded that these variables, due to their temporal order of occurrence in comparison to suicidal ideation, are worth investigating as potential risk factors. This assumption could play an important role in identifying groups at risk and help mental health policymakers better target preventive interventions to individuals with these types of histories. In addition, potentially modifiable protective factors such as social support, while requiring further investigation, may be valuable considerations in the development of preventive interventions.

Strengths and Limitations

To our knowledge, this is one of the few studies to use network analysis to examine suicidal ideation in a nonclinical sample of college students. Previous studies have focused primarily on clinical samples and investigated risk factors in isolation, whereas this study attempted to provide a more comprehensive picture of the relationships between variables associated with suicidal ideation in a nonclinical population by using network analysis.

Another strength of this study is the examination of gender differences in network structure. By combining theoretical background related to differences between men and women in the context of factors associated with suicidal ideation and analysing network structure by gender, this study attempted to provide a more accurate picture of these gender differences in this sensitive phenomenon. Also, rather than focusing solely on internal and individual factors that are more difficult to identify and measure, this study used variables that relate to social aspects and life histories (such as perceptions of discrimination, traumatic childhood experiences, lifetime adversity, and social support). This approach could help better identify at-risk groups and provide mental health researchers and policymakers with a deeper understanding of the external factors associated with suicidal ideation.

This study has various limitations. First of all, the data examined in this study are cross-sectional, which means that no conclusion regarding the direction of the associations can be made, and makes causal inferences impossible. In addition, the gender composition of the study sample did not accurately reflect the actual population, with only 15.8% of participants identifying as men and 80.4% as women. Although the number of individuals identifying as men allowed for the calculation of the required nodes for network analysis, this gender imbalance was challenging in some parts of the statistical analyses, as, for example, it limited the power of NCT to detect real differences between networks.

Another notable limitation that warrants further attention is the skewed distribution of the suicidal ideation variable within this nonclinical sample. Such skewness can reduce variability and consequently diminish the statistical power to detect significant relationships involving suicidal ideation. This limitation might help explaining some of the null findings observed in the study and highlights the challenges of investigating suicidal ideation in nonclinical populations where suicidal ideation tends to occur at lower and less variable levels. Lastly, the centrality indices in this sample did not demonstrate sufficient statistical stability, and therefore conclusions based on these indices are considered methodologically invalid, which limits the extent to which the results of the current study can be interpreted.

Conclusion

This thesis investigated the interconnections between childhood trauma, lifetime adversity, perceived discrimination, social support, and suicidal ideation in a non-clinical sample of university students from a gendered perspective. The main findings revealed that among women and men, respectively, higher levels of lifetime adversity and childhood trauma were associated with higher levels of suicidal ideation. For women, social support emerged as a protective factor against suicidal ideation, whereas among men, this direct association was not observed. However, the NCT did not report any statistically significant difference between men's and women's network in terms of social support's role. These inconsistent findings highlight the need for replication with larger and more balanced samples, as the lack of significant results may partly reflect limited statistical power, particularly due to the smaller and unequal sample size in the male group. Given the cross-sectional nature of the data and the gender imbalance in the sample, only limited conclusions can be drawn from the observed patterns. Nonetheless, the findings highlight the importance of considering both experiential and social factors in understanding suicidal ideation, and support the integration of trauma history and social support into targeted prevention strategies.

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Appendices

Appendix A: Further Information of the Research Procedure

A change in the research proposal

The initial research design differed from what has now been conducted and reported. Originally, the study included an additional node (suicide attempt), and both suicide attempt in the past year and social support were variables measured at the one-year follow-up. However, due to the very small number of participants reporting a suicide attempt (n = 6) and the limited response rate to follow-up questions (30 men and 170 women), analysing risk factors for suicide attempt and comparing the two networks became challenging. As a result, suicide attempt was removed from the analysis, social support was instead analysed using the data gathered at baseline, and to ensure better temporal alignment with other variables, lifetime suicidal ideation was modified to suicidal ideation in the past 12 months.

Change in Network Estimation Method

Initially, as stated in the research proposal, JASP version 0.19.3.0 was selected for the analysis. After estimating the networks in JASP and performing bootstrapping, the results appeared highly unstable and inconsistent. Given these irregularities, I consulted my supervisor, who replicated the analysis using the same dataset in JASP. While the estimated network structure remained similar, the bootstrapping results in my supervisor's JASP version demonstrated significantly higher stability, which was not observed in my own JASP analysis. To further investigate this discrepancy, we conducted additional analyses using R. The results obtained from R closely matched those from my supervisor's JASP analysis, suggesting that the instability observed in my own JASP results might be due to software-specific factors. Consequently, we decided to estimate the networks using R and also calculate the stability of edge weights and centrality metrics within this framework based on my supervisor's computations in R.

Moreover, it should be noted that the study's bootstrapping tests were conducted using R and with the help of the supervisor. The original plan was to conduct the analysis using JASP version 0.19.3.0. Due to the inconsistency discussed before, we made the decision to use R.

Appendix B: Questionnaires

Childhood Trauma

Childhood Trauma was measured using the 5-item version of the Childhood Trauma Questionnaire Short Form (CTQ-SF). (Grabe et al., 2012). Participants answered to a questionnaire with the following heading:

"These questions ask about some of your experiences growing up as a child and a teenager. For each question, select the answer that best describes how you feel. Although some of these questions are of a personal nature, please try to answer as honestly as you can. We want to remind you that all information you provide us as part of the WARN-D study is strictly confidential, of course. When I was growing up…"

Then, they answered to the following items from a range of 1 (never true) to 5 (very often true).

1. I felt loved.
2. People in my family hit me so hard that it left me with bruises or marks.
3. Someone in my family hated me.
4. Someone molested me (took advantage of me sexually).
5. There was someone to take me to the doctor if I needed.

Lifetime Adversity:

Questions regarding lifetime adversity were adapted from the *Life Events Checklist for DSM-5* (LEC-5; Gray et al., 2004) and implemented during the first stage of the study. Participants were asked to respond to a questionnaire with the following instruction:
"Listed below are a number of difficult and stressful things that sometimes happen to people. Please indicate for each event whether it ever happened to you personally, whether you witnessed it happening to someone else, or whether it does not apply to you."
For the purposes of the WARN-D study, the LEC-5 was adapted by removing the item "combat or exposure to a war zone" to minimize irrelevant content. The final list of items participants responded to is as follows:

1. Natural disaster (e.g., flood, hurricane, tornado, earthquake)
2. Fire or explosion
3. Transportation accident (e.g., car accident, boat accident, train wreck, plane crash)
4. Serious accident at work, home, or during recreational activity
5. Exposure to toxic substance (e.g., dangerous chemicals, radiation)
6. Physical assault (e.g., being attacked, hit, slapped, kicked, beaten up)
7. Assault with a weapon (e.g., being shot, stabbed, threatened with a knife or gun)
8. Sexual assault (e.g., rape, attempted rape, being forced to perform any type of sexual act through force or threat of harm)
9. Other unwanted or uncomfortable sexual experience
10. Life-threatening illness or injury
11. Severe human suffering
12. Sudden violent death (e.g., homicide, suicide)
13. Sudden accidental death
14. Serious injury, harm, or death you caused to someone else
15. Any other very stressful event or experience

Social Support

The questions regarding social support were adapted from "Questions from Caring Universities," (SocSup_Argue), which was based on the Supportive and Negative Social Interaction Scale (SIS) (Schuster et al., 1990). In the questionnaire, each subconstruct of social support was assessed with a single item, rated on a scale from 1 (not at all) to 5 (extremely). The following questions were used:

1. How much do the people in your personal life make you feel loved and cared for?
2. How much can you depend on the people in your personal life for help when you need it?
3. How much do the people in your personal life understand the way you feel about things?
4. How often do the people in your personal life make unreasonable demand on you?
5. How often do the people in your personal life argue with you or say things that make you feel bad?

Perceived Discrimination

Perceived discrimination, assessed at baseline, was measured using the *Williams Everyday Discrimination Scale* (1997). Participants were asked to respond to the following items under the heading: *"*How often are you discriminated against because of such things as your race, ethnicity, gender, age, religion, physical appearance, sexual orientation, or other characteristics?*"* Responses were rated on a scale from 1 (never) to 6 (almost every day). The items included:

1. You are treated with less courtesy than other people are
2. You are treated with less respect than other people are
3. You receive poorer service than other people at restaurants or stores
4. People act as if they think you are not smart
5. People act as if they are afraid of you
6. People act as if they think you are dishonest
7. People act as if they're better than you are
8. You are called names or insulted
9. You are threatened or harassed

Appendix C: Figures and Tables

Table C1

Demographic Characteristic of Participants

Variable	Category	Mean (SD)	Min	Max	Frequency (%)
Age	—	22.61 (4.02)	18	61	—
Gender	Man	—	—	—	96 (15.84%)
	Woman	—	—	—	487 (80.36%)
	Other	—	—	—	21 (3.46%)
Sex	Male	—	—	—	92 (15.18%)
	Female	—	—	—	513 (84.65%)
Nationality	Dutch	—	—	—	330 (54.45%)
	Other	—	—	—	217 (35.81%)
	More than one	—	—	—	59 (9.74%)
International Student	No	—	—	—	343 (56.60%)
	Yes	—	—	—	263 (43.40%)

Note. SD = Standard Deviation

Table C2

Normality Assessments

	CTQ	SI	LA	SS	PD
Skewness	1.675	4.190	0.974	-0.523	1.664
Std. Error of Skewness	0.099	0.099	0.099	0.099	0.099
Kurtosis	3.124	19.946	1.085	0.320	4.872
Std. Error of Kurtosis	0.198	0.198	0.198	0.198	0.198
Shapiro-Wilk	0.814	0.404	0.923	0.971	0.845
P-value of Shapiro-Wilk	< .001	< .001	< .001	< .001	< .001

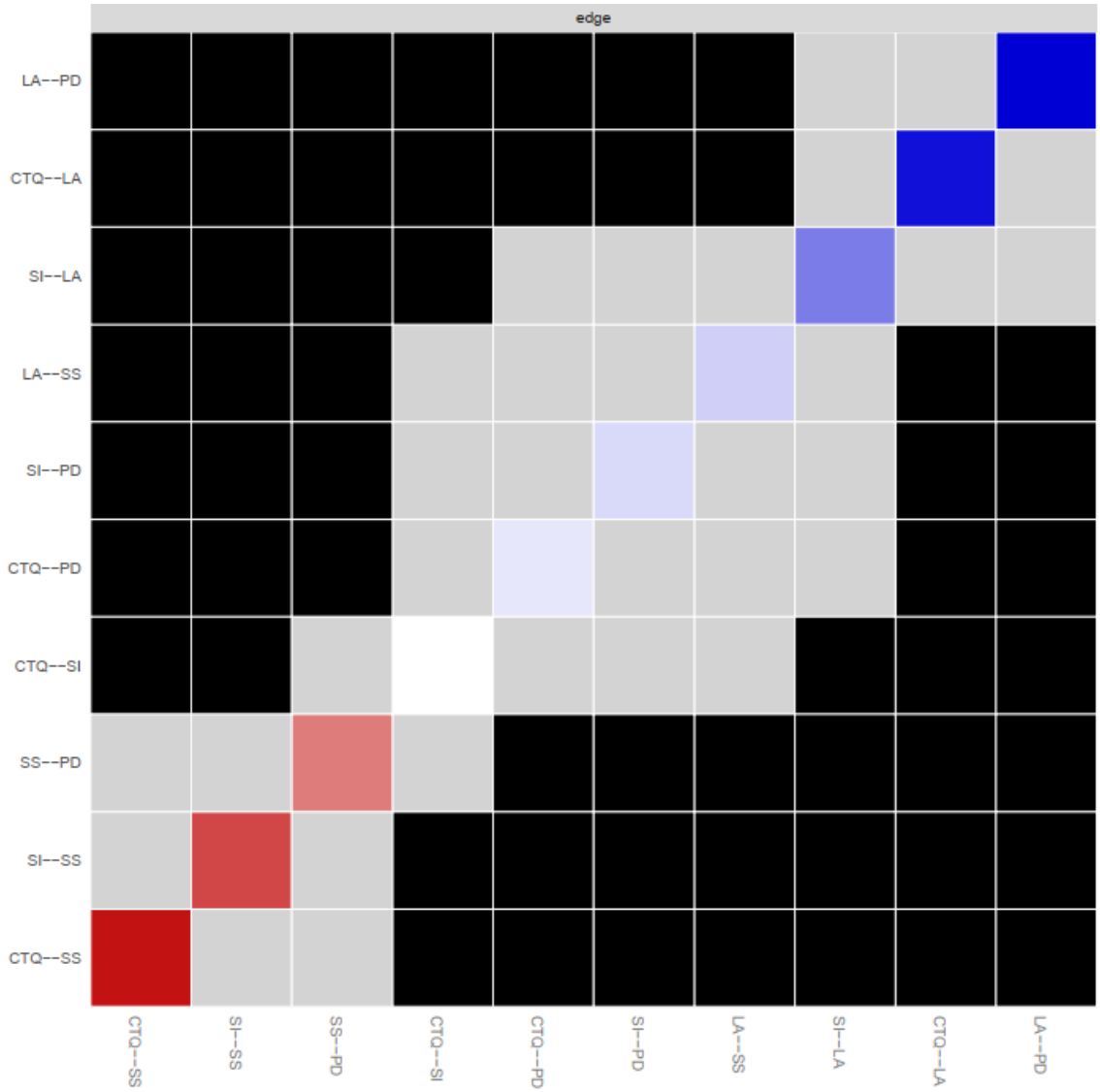
Table C3

Specific Edge Weight of Each Construct

Variables	Man					Woman				
	ctq	*SI*	*LA*	*SS*	*PD*	*ctq*	*SI*	*LA*	*SS*	*PD*
ctq	0.00	0.18	0.14	-0.28	0.23	0.00	0.00	0.27	-0.27	0.03
SI	0.18	0.00	0.14	0.00	0.00	0.00	0.00	0.15	-0.21	0.04
LA	0.14	0.14	0.00	-0.09	0.11	0.27	0.15	0.00	0.05	0.29
SS	-0.28	0.00	-0.09	0.00	-0.22	-0.27	-0.21	0.05	0.00	-0.15
PD	0.23	0.00	0.11	-0.22	0.00	0.03	0.04	0.29	-0.15	0.00

Figure C4

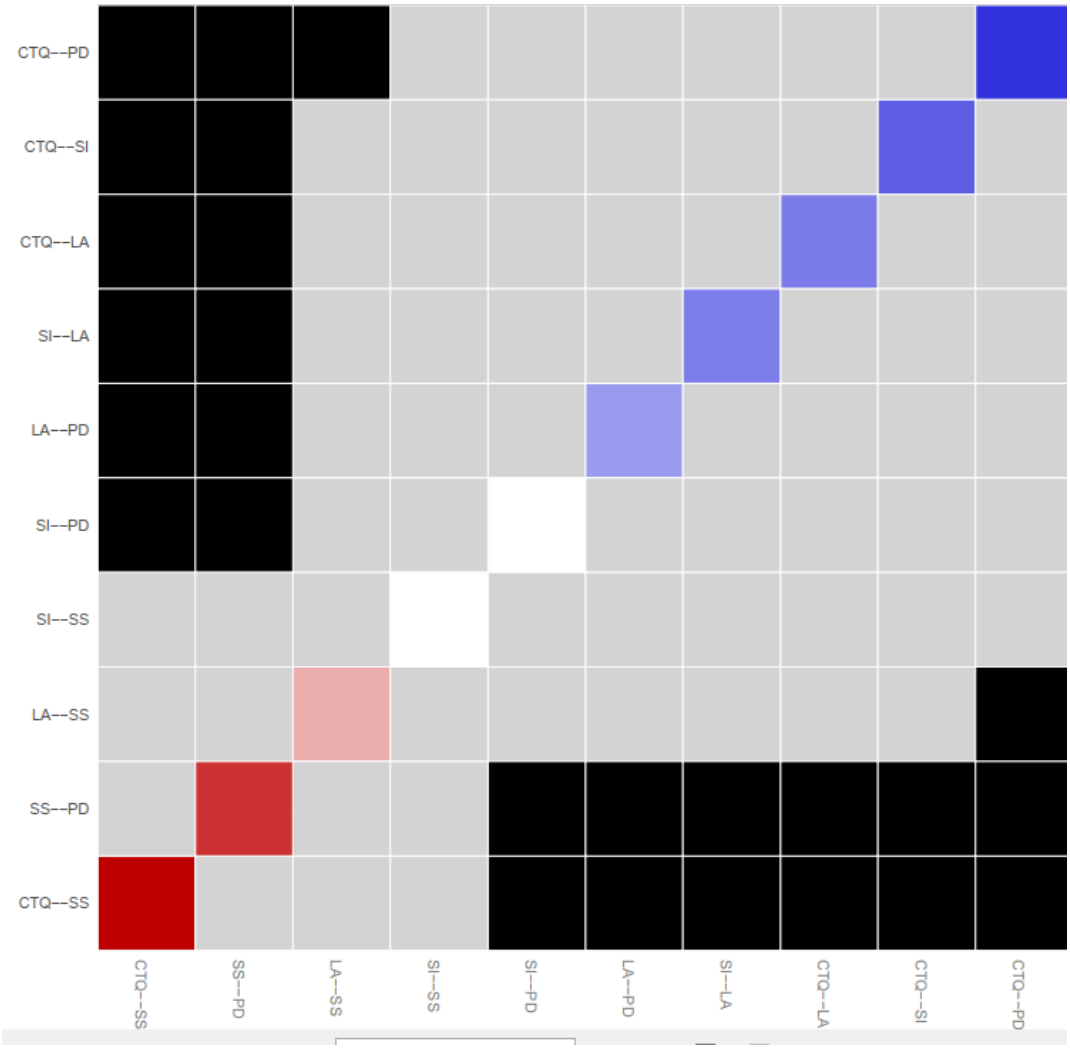
Results for Edge Weight Difference Tests for women



Note. Results from the bootstrapped edge weight difference test. Each cell represents a pairwise comparison between two edges within the network. Black cells indicate statistically significant differences, while gray cells represent non-significant comparisons.

Figure C5

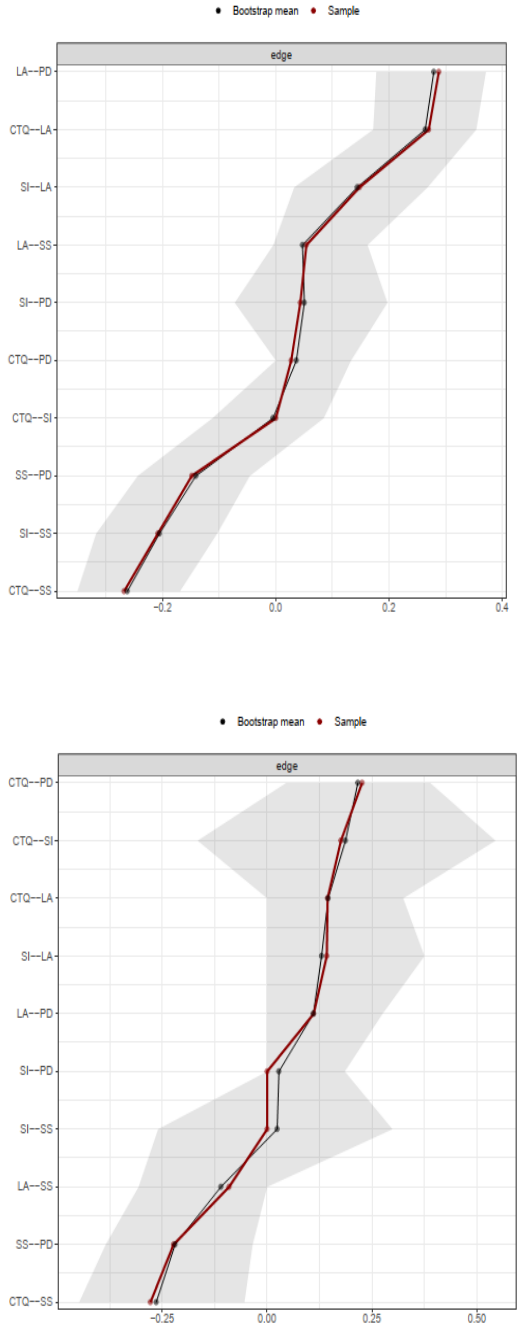
Results for Edge Weight Difference Tests for Men



Note. Results from the bootstrapped edge weight difference test. Each cell represents a pairwise comparison between two edges within the network. Black cells indicate statistically significant differences, while gray cells represent non-significant comparisons.

Figure C6

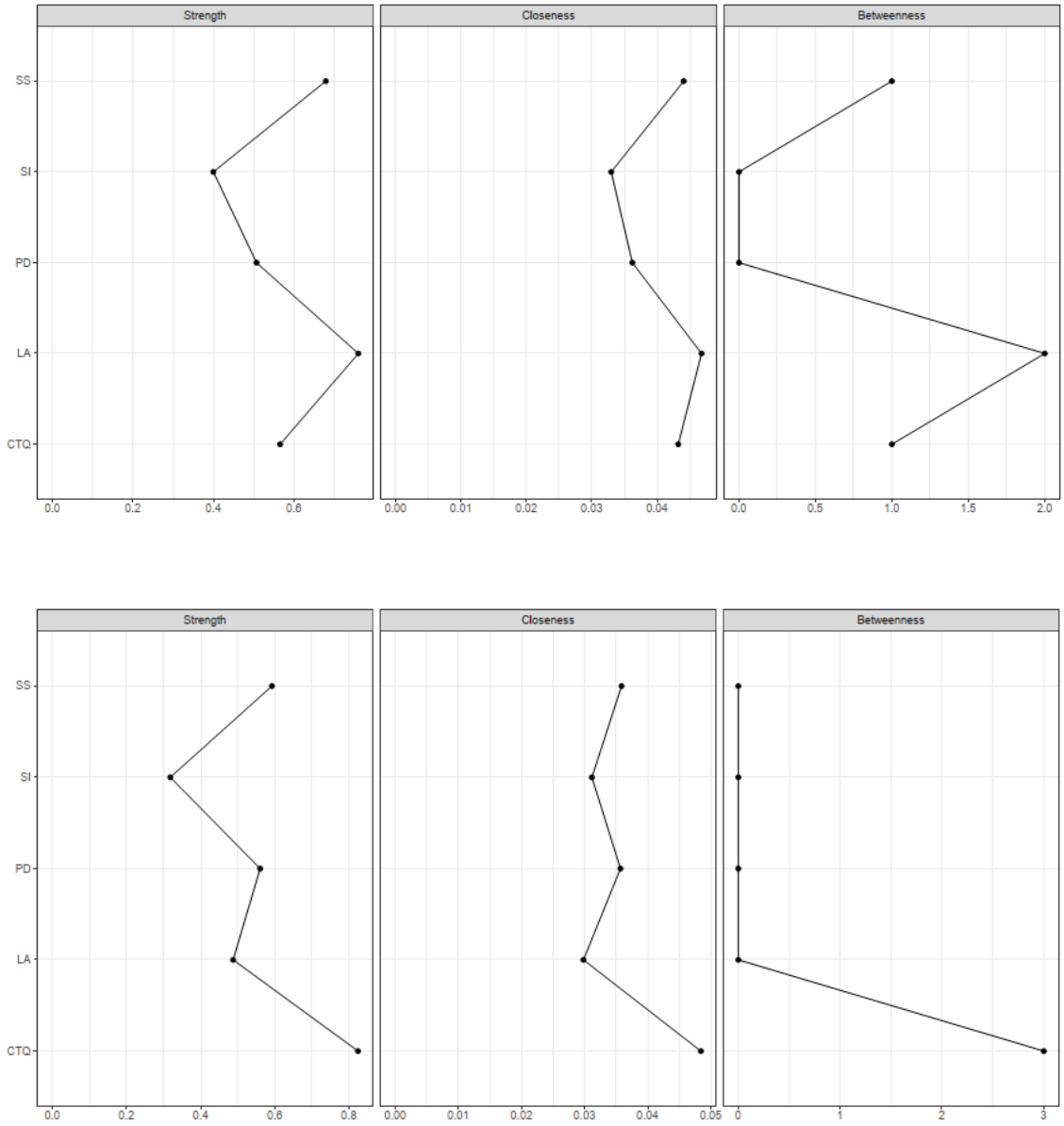
Edge Weight Accuracy of Women's (First) and Men' (Second) Network Using R



Note. Accuracy is illustrated by bootstrapped confidence intervals using 1,000 iterations. Each horizontal line corresponds to a specific edge within the network. The black points are bootstrapped mean values, while res dots are the sample values. Grey area illustrates the bootstrapped confidence interval.

Figure C7

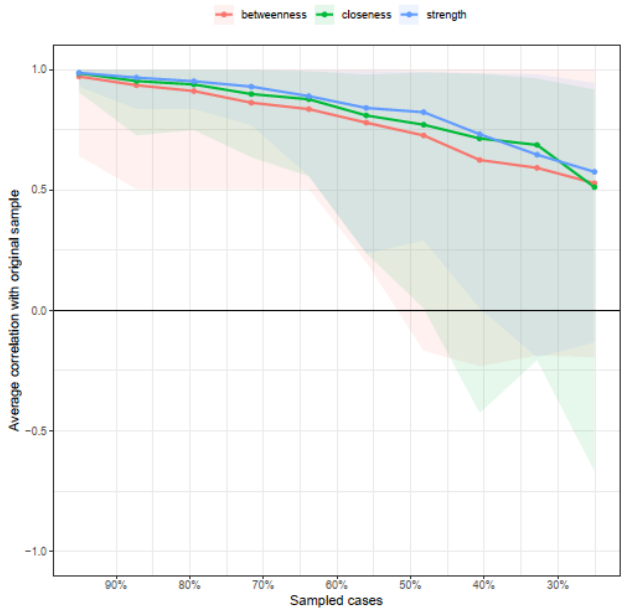
Centrality Measures for Women (First) and Men (Second)

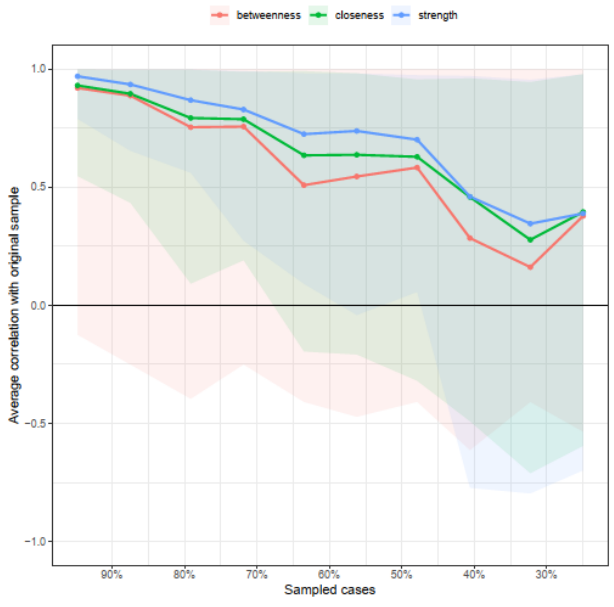


Note. The values are standardized z-scores.

Figure C8

Visual Results of Case-drop Bootstrapping with 1,000 Iterations for Women (First) and Men (Second) Using R





Note. Comparison of average centrality indices between the original sample and case-drop bootstrapped samples. Shaded regions represent 95% confidence intervals from 1,000 bootstrap iterations; solid lines indicate mean values