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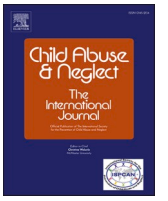

Gendered risks to children and adolescents assessed by Child & Adolescent Mental Health Services (CAMHS): Perspectives from network analysis

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ABSTRACT

Background: Early exposure to risk and adversity is a potent predictor of mental health difficulties. Though risks vary by gender, little attention was paid towards the associations both within risks and of risks across genders.
Objective: We sought to identify networks of a wider range of risks (experiences and behaviors that might threaten the person's wellbeing and safety before the age of 18 years). And we aimed to have a better understanding of the specific risk configurations across genders and to develop potential clinical interventions.
Participants and setting: This study explores network structures of early risks among 45,210 children and adolescents (aged 5 to 18) from longitudinal data in the UK.
Methods: Network analysis was applied to investigate the associations among risks and to identify the central risks across genders.
Results: Stable connections across genders in different assessments of risks (e.g., risks of self-harm and suicide). Risks related to violence could be core risks in all networks. Some gender differences in the context of early risks are also identified. For example, substance misuse and exhibiting violent or offending behavior are more closely associated among the male children that took the Brief Risk Assessment.
Conclusions: Gendered associations between risks could be of value for both intervention and prevention. More attention should be paid to risks related to violence in clinical practice and policy making. Future study could record risks more precisely, utilize data from multiple time points and take more social-demographic factors into consideration to obtain integrated and comprehensive results.

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1. Introduction

In the UK, there is a significant and growing demand for mental health services for children and adolescents (Fledderjohann et al., 2021). Evidence from numerous studies suggests that early exposure to risk and adversity is a potent predictor of mental health difficulties (Wagner et al., 2024). A well-established concept in this field is adverse childhood experiences (ACEs), which are generally defined as experiences of childhood maltreatment and household dysfunction occurring before the age of 18 years (Felitti et al., 1998). There is a large body of epidemiological research that has found replicable, graded associations between ACEs and negative outcomes in adulthood (Hughes et al., 2017).

However, though it's widely used in both research and implementation (Danese et al., 2020; Hughes et al., 2017; Swedo et al., 2023), ACEs might not capture the complexity of people's adverse experiences. For example, the ACE questionnaire does not capture (Cronholm et al., 2015; Finkelhor, 2018) exposure to experiences such as community violence or peer victimization, which are commonly recognized childhood adversities (Cronholm et al., 2015; Finkelhor, 2018). The detection of such adversities is also vital for public services, particularly within acute institutions (Laake et al., 2025). It should be noted that some research investigate poly-vitimization based on ACEs (Siciliano et al., 2025; Voith et al., 2020). However, there is recent research indicating that the measurement of childhood adversity should be broader and more precise (Tsai et al., 2025; Valentino & Edler, 2024), which is one of current research's aims to bring all these concepts together. In addition, based on risk cumulative model, most research generally treats ACEs homogeneously. The dominant use of crude cumulative scores also received some criticism (Anda et al., 2020; LaNoue et al., 2020). The homogeneous scores do not consider the specific risk configurations across individuals (Evans et al., 2013), as well as do not taking chronicity or severity of ACEs when scoring them (Anda et al., 2020). According to differential susceptibility theory (Belsky et al., 2007), people could response to risks differently even if they share the same scores of ACEs. Thus, instead of treating risks homogeneously, it could be helpful to investigate risks dynamically. One way to address this concern is through network model of psychopathology (Epskamp et al., 2018), which captures associations between variables as a network. Through network analysis, associations among specific risks could be analyzed, as well as identifying the potential core risks among risk networks. Some researchers already use network analysis to investigate early risks, such as illuminating the intergenerational transmission of adversity (Carozza et al., 2022; Hemady et al., 2022). However, research is limited in the context of ACEs, and border investigation of risks and adversities remains needed.

Another limitation of ACEs studies is that they are generally based on self-reported retrospective assessments from adults (Carozza et al., 2022; Hemady et al., 2022). The nature of retrospective investigation might limit the reliability and validity of their findings due to recall bias. In addition, the self-reported measurement could induce social desirability and under-reporting due to stigma (Eliassen, 2024; Hauer & Hung, 2022). Also, the retrospective measures of mental health outcomes could bring considerable bias (Reuben et al., 2016). One way to address this is to use timely recorded data (e.g., data from clinicians). In the UK, one vital mental health service provider is Child & Adolescent Mental Health Service (CAMHS). In CAMHS, a risk assessment must be completed by professionals to assess the level of risks to children and young people (Aggett & Messent, 2019), which is used to develop intervention plans. To distinguish risks from ACEs, we defined risks as ‘a set of experiences and behaviours that might threaten the person's wellbeing and safety before the age of 18 years’, which has a larger content compared with ACEs. It could be divided into several constructs, including individual-level vulnerability, risky behavior, familial risk, interpersonal risk and community insecurity. And it is also discussed by some researchers that the data from CAMHS is helpful for identifying associations between risks and mental health problems (Coughlan et al., 2025). These findings contribute to the investigation of early risks in childhood and emphasize the importance and potential benefits of understanding them.

Furthermore, it has been reported that there are gender differences in early risks (Tian et al., 2024; van Goozen et al., 2022; Walker et al., 2022; Winstanley et al., 2020; Zhu et al., 2025). First, the presence of risks could differ in genders. For example, females could not only have more adverse childhood experiences compared to males but also have higher prevalence of sexual abuse (Winstanley et al., 2020). By contrast there is evidence the males have higher rate of substance use (van Goozen et al., 2022; Walker et al., 2022). Second, the associations between risks and mental health outcome could also vary by gender. For example, the association between witnessing physical violence in childhood and experiencing physical violence from a partner in adulthood is stronger in females than in males (Tian et al., 2024). Additionally, a recent meta-analysis indicated that women with two adverse childhood experiences had higher relative odds of experiencing anxiety compared to men (relative odds ratio = 2.04, 95% CI: 1.15–3.62) (Zhu et al., 2025). These results indicated that the risks could be associated with themselves differently across genders. However, previous research mainly focuses on presence of risks and the associations between risks and mental health outcomes, the associations both within risks and of risks across genders, have received little attention.

To overcome these limitations and to expand methodological approaches to ACEs, this study applies network analysis to explore the extended risks based on longitudinal clinical records data from CAMHS, which covers early risks of children and adolescents over 10 years in the UK. Our aims are twofold: (1) identifying the network structures of various early risks of children and adolescents; (2) identifying similarities and differences across genders. Through these identifications, potential clinical intervention strategies could be developed. Notably, given the nature of network analysis, the results could be vast. Thus, we mainly focused on risks beyond traditional ACEs (e.g., interpersonal risk and community insecurity) and comparing networks between high-risk group and others.

2. Method

2.1. Data and participants

This study is based on Child & Adolescent Mental Health Service (CAMHS) provided by South London and the Maudsley (SLaM) NHS Foundation Trust (research ethical approval reference: 08/H0606/71+5, approved by South Central - Oxford C Research Ethics Committee). As one of the largest mental health providers in Europe, it covers over 1.3 million people within four London boroughs: Croydon, Lambeth, Southwark and Lewisham. The data were extracted using the Clinical Record Interactive Search (CRIS) to protect participants' privacy. The extracted data includes risk assessments, clinical diagnosis of mental disorders, and socio-demographic factors. Notably, though the original data was collected based on gender identity, the extracted data only included 'male' and 'female' as they are predominant and make more sense to young children (e.g., 0–11 years old). Details regarding the data could be found in Perera's research (Perera et al., 2016). Overall, 101755 records between January 2007 and October 2023 were extracted. After data cleaning (see Fig. 1), 45210 participants aged 5 to 18 were included, among which 18,646 participants received the 'Brief Risk Assessment', 29,018 participants received the CAMHS 'New Risk Assessment', and 4669 participants received the 'Full Risk Assessment'. Notably, there are two reasons for excluding children younger than 5 years old. First, children aged 0–4 might be too young to assess mental health problems. Second, from age 5, children in the UK generally start their education in state school system of UK, which could make children receive additional education and attention regarding their mental health.

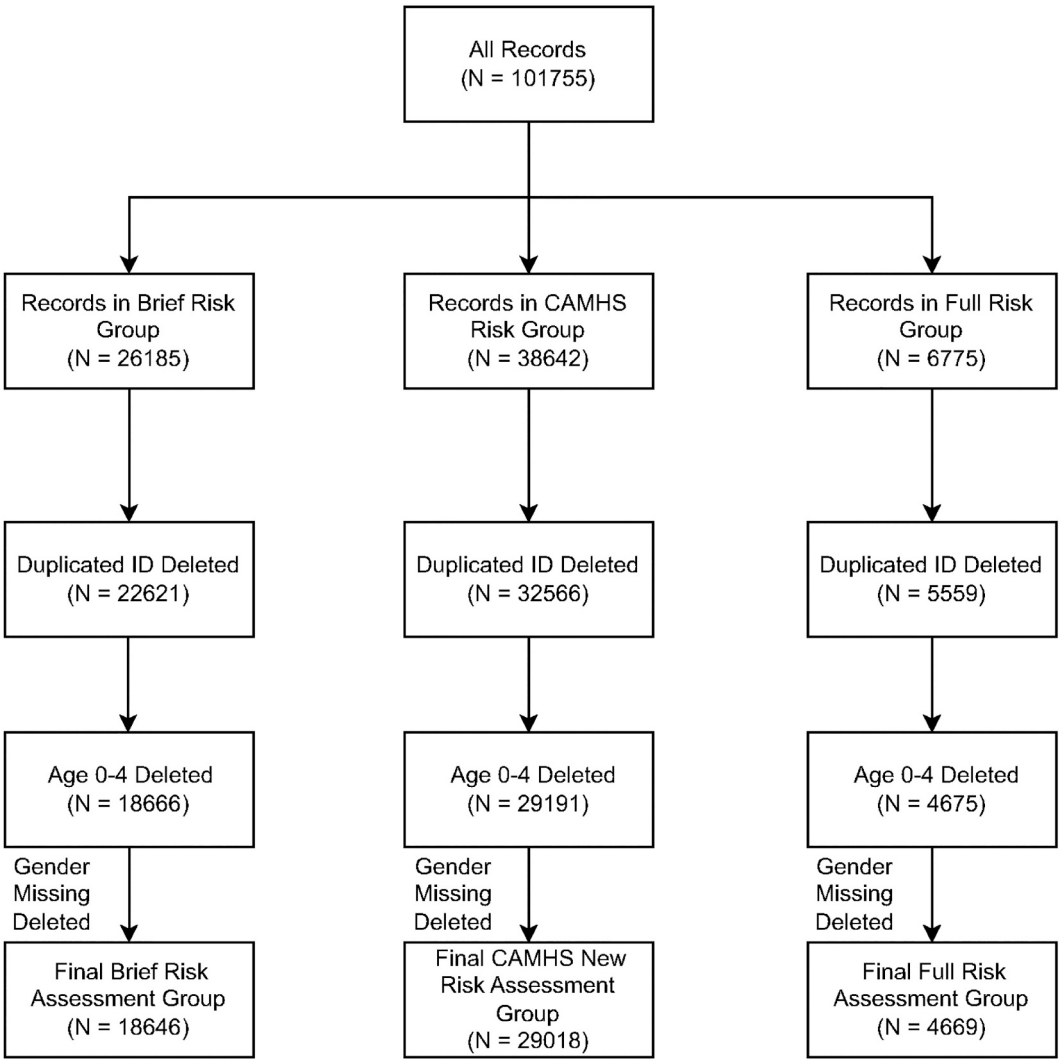

Fig. 1. Flow chart of data cleaning.

2.1.1. Early risks assessments

There were three kinds of assessments applied in CAMHS in the NHS Trust: the 'Brief Risk Assessment', the CAMHS 'New Risk Assessment', and the 'Full Risk Assessment'. All these three were developed by clinicians based on practice-based evidence. The 'Brief Risk Assessment' and 'Full Risk Assessment' were used between 2007 and 2017. And the 'Full Risk Assessment' was applied when participants were defined as high risk (e.g., likely to suicide) by clinicians. Though such definition is designed to be based on 'Brief Risk Assessment' if patients present high risk in one of three domains: (1) to oneself; (2) to others and (3) from others (Lopez-Morinigo et al., 2016), the clinicians could occasionally have their own judgement beyond assessment. Later, the CAMHS New Risk Assessment was developed in 2014 to supersede these two assessments, but the latter remained in use until 2017.

We deleted some items (two in the CAMHS New Risk Assessment and one in the Brief Risk Assessment) due to low response rates. The percentages of deleted items are 0.1% (for both items in CAMHS New Risk assessment) and 0.5% (for item in Brief Risk Assessment), which is much lower than the threshold (5%) of completely random missing (Jakobsen et al., 2017). The percentages are also much lower than other response rates of other items. The details of the three assessments included and excluded can be seen in Supplementary (Tables S1–S3). The use of three different risk assessments by CAMHS, each seeking to assess the extent of risk, adds complexity but also offers an advantage to this study in helping to explore the extent to which findings differ depending on how risk has been assessed. Under some circumstances, some children might receive more than one assessment across risk assessments. To avoid multiple records of one person in a risk assessment, we used the first record of multiple records in each risk assessment group, which represents their initial status when they first entered the CAMHS.

2.2. Data analysis

All data analysis was conducted using software *R* (version 4.2.1). We used network analysis for three main reasons: first, it could take all the risks into one estimation procedure and discover the connections between risks; second, it could indicate which risk was the most central (and should therefore receive more attention); and third, in the end, it could visualize the analysis result, which might aid comprehension. Based on network analysis, we could discover the potential connections among risks and compare these results with previous studies (whether they used network analysis or not). This might help us better understand the associations among risks and develop new ways of prevention or intervention (i.e. we could target key risks for intervention, and in doing so make intervention more effective and specific). The implications for clinical practice could, however, be limited - this is discussed further in the Limitation section.

2.2.1. Network estimation

We estimate the structure of networks via *R*-package qgraph (Epskamp et al., 2018). A coupling matrix network was separately estimated for the risks included in each risk assessment. Due to the binary characteristic of risks, we used IsingFit rather than Gaussian Graphic Model to estimate associations among them (Borsboom et al., 2021). Extended Bayesian Information Criterion (EBIC) was used to regularize the estimation under the default model ($\gamma = 0.25$). Each connection (edge) between risks (nodes) can be interpreted as the direct strength of interaction or dependence, indicating the relationship between nodes after controlling for the influence of all other nodes in the network. The positive edges indicate that two risks are positively associated, while the negative edges indicate that two risks are negatively associated.

For visualization of the network, we used the Fruchterman-Reingold algorithm to place nodes with stronger connections closely (Fruchterman & Reingold, 1991). We visualized positive edges in blue and negative edges in red. To get better comparison across networks, we set minimum edge weight based on average strength of edges and set maximum edge weight slightly above the largest observed edge weight.

2.2.2. Centrality estimation

We applied centrality estimation to assess the strength of each node. There are various optional centrality estimates, but we included strength centrality and expected influence centrality as betweenness and closeness centrality tend to be unstable (Bringmann et al., 2019; Hallquist et al., 2021). Strength centrality is the sum of the absolute values of all edges connected to one node, while the expected influence centrality is the sum of values of all edges connected to one node (Borsboom et al., 2021). These two indicators were used for identifying which risks were the most informative for these network structures. For example, when a risk has the highest strength centrality, this means it is strongly associated (both positively and negatively) with all the other risks. To obtain a better comparison, we calculated the z-scores of original centralities.

2.2.3. Network accuracy and stability estimation

Bootstrapped estimates and confidence intervals (1000 iterations) of the edge weights were calculated to investigate the stability and accuracy of edges (Epskamp et al., 2018). We calculated correlation stability (CS) coefficient to indicate the robustness of the strength centrality estimation (Costenbader & Valente, 2003), which should be at least 0.25 and preferably above 0.5 (Epskamp et al., 2018).

2.2.4. Network comparison

To compare network structures across genders, we applied a network comparison test, which tests network invariance, global strength invariance, edge invariance and centrality invariance (Fried et al., 2017). All network comparisons were conducted using the *R*-package 'Networkcomparisontest' (van Borkulo et al., 2023). Network invariance and global strength invariance test for differences

in the entire network structure, while edge invariance tests for differences in edge weights. Centrality invariance tests the invariance of strength centrality between networks.

3. Results

3.1. Participants characteristics

Table 1 shows a basic description of the participants' characteristics of each risk group, including age, gender, ethnicity and index of multiple deprivation. There are 8250 female participants (44.25%) in Brief Risk Assessment group, 15340 female participants (52.86%) in CAMHS New Risk Assessment group and 2233 female participants (47.83%) in Full Risk Assessment group. Across the groups, the mean age in each group was 11.83, 12.34 and 12.81 respectively. The predominant ethnicity is White across three risk assessment groups. And most children and adolescents live in a region with a relatively higher index of multiple deprivation.

3.2. Networks

In Brief Risk Assessment, there were three (individual-level vulnerability), 13 (risky behavior), four (familial risk), four (interpersonal risk) and four (community insecurity) risks in each category. In CAMHS New Risk Assessment, there were one (individual-level vulnerability), six (risky behavior), one (familial risk), one (interpersonal risk) and one (community insecurity) risks in each category. In Full Risk Assessment, there were 17 (individual-level vulnerability), 21 (risky behavior), six (familial risk), five (interpersonal risk) and nine (community insecurity) risks in each category. Among some common risks, Full Risk Assessment group has higher proportions (e.g., self-harm), which might be due to the nature that the group was defined as high risk (e.g., likely to suicide) by clinicians.

Fig. 2 visualizes the estimated coupling matrix networks in the group of children who received the Brief Risk Assessment. For children who received the Brief Risk Assessment, the maximum edge strength is 2.89; the mean edge strength is 0.22. The strongest positive edge is between nodes BR11 (physical abuse to others) and BR15 (violence towards others), and the strongest negative edge is between nodes BR28 (concern of young person) and BR22 (self-learning disability, indicating whether a person has learning disability). BR3 (emotional abuse) and BR4 (physical abuse) show a strong connection as well.

These edges also exist in both male and female groups who received the Brief Risk Assessment (with the maximum edge strength of 2.69 and 3.01 respectively, and the mean edge strength of 0.23 and 0.21 respectively). However, among those that received the Brief Risk Assessment, BR13 (offending others) and BR19 (self-substance misuse, indicating whether a person engages in substance misuse) have a relatively stronger association in the male group than the female group (values of 1.92 and 0.94 respectively). Also, BR14 (dangerous behavior towards others) and BR25 (self-risk-taking behavior) have a weaker association in this female group.

Fig. 3 presents the estimated coupling matrix networks in the group of children who received CAMHS New Risk Assessment. The maximum edge strength is 2.54 and the mean edge strength is 0.55 in the overall group. CA6 (self-harm,) and CA7 (suicide) have the strongest positive association within the network, while CA7 (suicide) and CA9 (violence towards others) share the only negative edge. In male and female groups who received the CAMHS New Risk Assessment, the order of edges is the same as in group of children who received the CAMHS New Risk Assessment (with the maximum edge strength of 2.43 (male) and 2.44 (female) and the mean edge strength of 0.55 (male) and 0.53 (female)).

Table 1
Characteristics of participants.

Variables	Brief risk assessment group (N = 18,646)	CAMHS new risk assessment group (N = 29,018)	Full risk assessment group (N = 4669)
Age (mean, SD)	11.83 (3.63)	12.34 (3.70)	12.81 (3.46)
Genders			
Male (n, %)	10,396 (55.75%)	13,678 (47.14%)	2436 (52.17%)
Female (n, %)	8250 (44.25%)	15,340 (52.86%)	2233 (47.83%)
Ethnicities			
Asian or Asian British (n, %)	827 (4.44%)	1497 (5.16%)	233 (4.99%)
Black African/Caribbean British (n, %)	4985 (26.73%)	6266 (21.59%)	1165 (24.95%)
Mixed/multiple ethnicities (n, %)	1555 (8.34%)	3058 (10.54%)	352 (7.54%)
White (n, %)	9369 (50.25%)	13,331 (45.94%)	2403 (51.47%)
Other ethnicities (n, %)	700 (3.75%)	1069 (3.68%)	130 (2.78%)
NA (n, %)	1210 (6.49%)	3797 (13.08%)	386 (8.27%)
Index of multiple deprivation			
1st quintile (n, %)	6175 (33.12%)	7188 (24.77%)	1529 (32.75%)
2nd quintile (n, %)	6533 (35.04%)	9981 (34.40%)	1601 (34.29%)
3rd quintile (n, %)	2910 (15.61%)	5729 (19.74%)	713 (15.27%)
4th quintile (n, %)	1340 (7.19%)	3073 (10.59%)	394 (8.44%)
5th quintile (n, %)	863 (4.63)	2227 (7.67%)	242 (5.18%)
NA (n, %)	825 (4.42%)	820 (2.83%)	190 (4.07%)
Number of average risks (n, SD)	4.52 (3.96)	1.15 (1.57)	8.27 (7.93)

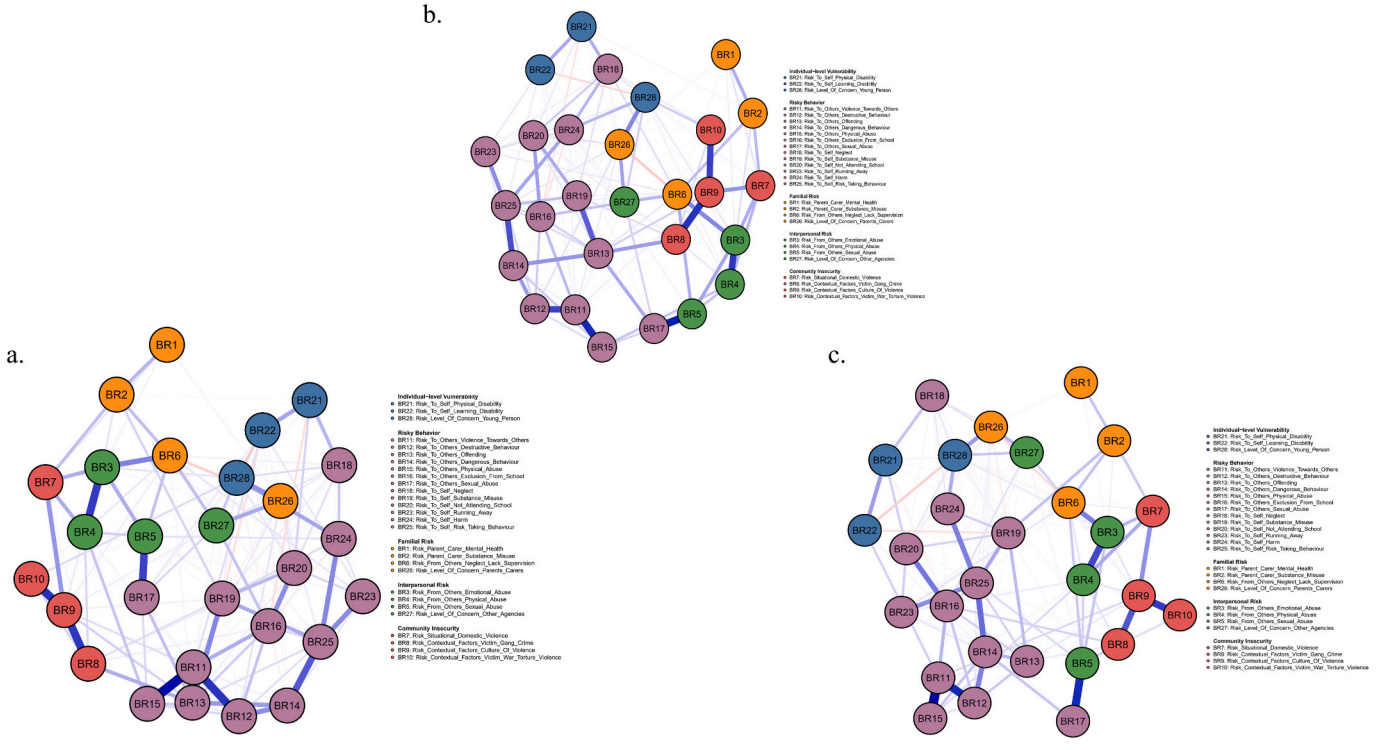

Fig. 2. Networks of the group of children who received the Brief Risk Assessment. Blue lines represent positive associations, red lines represent negative ones, and the thickness and brightness of an edge indicate the association strength. a. Network of overall group of children who received the brief risk assessment ($N = 18,646$). b. Network of male subgroup ($N = 10,396$). c. Network of female subgroup ($N = 8250$). Detailed description of risks can be found in Table S1 in supplementary. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

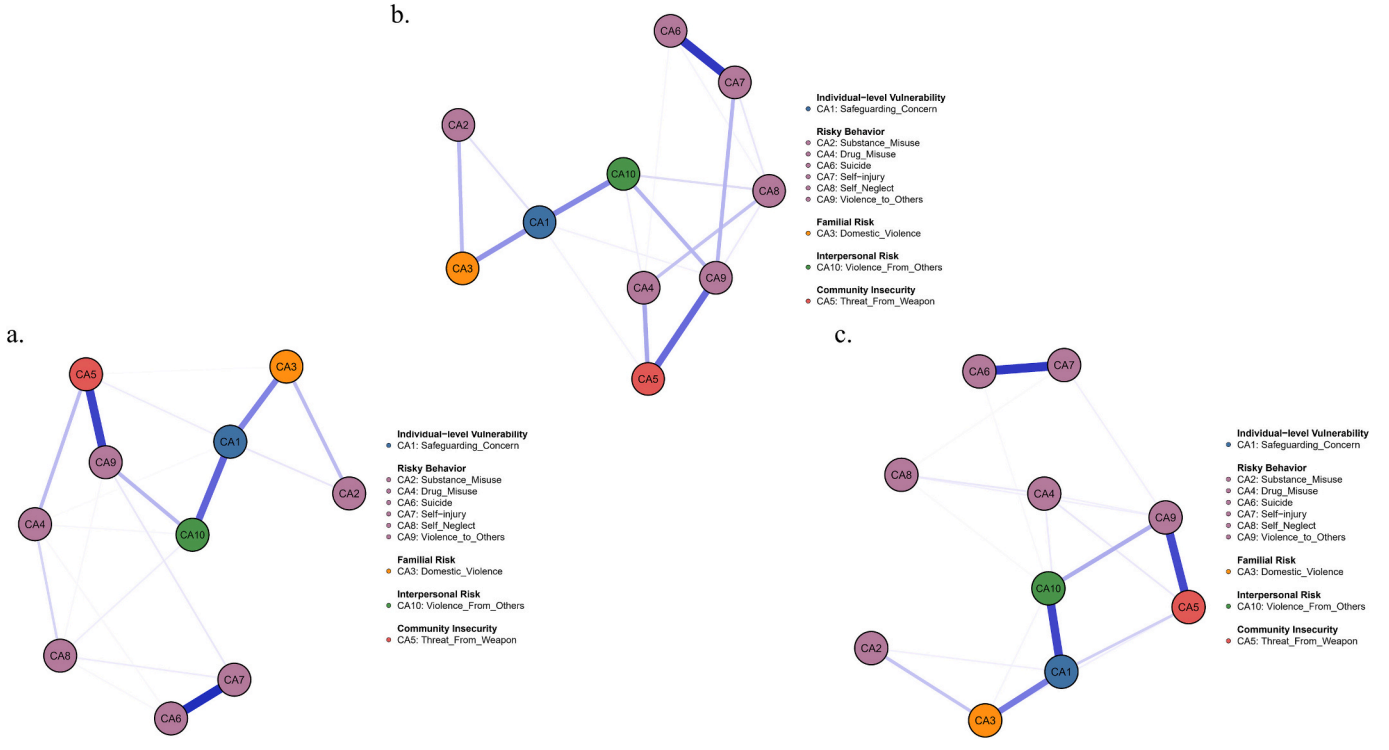

Fig. 3. Networks of the group of children who received the CAMHS New Risk Assessment. Blue lines represent positive associations, red lines represent negative ones, and the thickness and brightness of an edge indicate the association strength. a. Network of overall group of children who received the CAMHS New Risk Assessment ($N = 29{,}018$). b. Network of male subgroup ($N = 13{,}678$). c. Network of female subgroup ($N = 15{,}340$). Detailed description of risks can be found in Table S2 in supplementary. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

Fig. 4 shows the estimated coupling matrix networks in the group of children who received the Full Risk Assessment. The maximum edge strength is 4.43; the mean edge strength is 0.08. FL15 (suicide attempt) and FL16 (lethal method, suicide methods with high fatality rates) share the strongest positive edge, and FL2 (drug or alcohol misuse) and FL33 (difficulty communicating needs) hold the strongest negative edge. Though these edges present similarly in both male and female groups who received the Full Risk Assessment (with the maximum edge strength of 4.65 and 3.74 respectively and the mean edge strength of 0.07 for both), FL42 (sexual offences) and FL46 (abuse from others) connect closer in female subgroup who received the Full Risk Assessment.

3.3. Network centrality

Fig. 5 indicates strong centrality and expected influence in all three risk assessment groups. Fig. 5a to c shows the set of centralities of the groups of children who received the Brief Risk Assessment. The top three nodes with highest strong centrality are BR11 (physical abuse to others), BR25 (self-risk-taking behavior, taking risky behavior by oneself) and BR9 (culture of violence, living in a violent environment or receiving lots of information about violence), which is similar in female subgroup. In the male subgroup, BR13 (offending others) has the highest strong centrality.

For expected influence, the top three nodes are the same in the group of children who received the Brief Risk Assessment and the female subgroup, and BR25 (self-risk-taking behavior) takes the most central role in the male subgroup. The set of centralities of the groups of children who received the CAMHS New Risk Assessment is shown in Fig. 5d to f. The strong centrality and expected influence are consistent in the groups of children who received the CAMHS New Risk Assessment. CA1 (safeguarding concern) is the strongest node in the groups of children who received the CAMHS New Risk Assessment and the female subgroup, whereas CA9 (violence towards others) is the strongest in the male subgroup.

Fig. 5g to i presents the centralities of the group of children who received the Full Risk Assessments. Similar to the groups of children who received the CAMHS New Risk Assessment, the strong centrality and expected influence are consistent. The male subgroup's top three strongest nodes are FL14 (expressed concern), FL6 (antisocial behavior) and FL1 (history of violence), whereas they are FL11 (significant stress), FL14 (expressed concern) and FL15 (suicide attempts) in the groups of children who received the Full Risk Assessment and the female subgroup.

3.4. Network accuracy and stability

The supplementary (Figs. S1–S45) includes accuracy and stability of the estimated edges and centralities for each network. Across nine networks, all the edges and centrality stability estimates (both strong centrality and expected influence) are 0.75, which is considered adequate as they are larger than 0.5 (Epskamp et al., 2018).

3.5. Network comparison

To compare the differences between networks, we conducted the network comparison test. Global expected influence among the children who received the Brief Risk Assessment was 83.65 for the male group and 78.34 for the female group. Among the children who received the CAMHS New Risk Assessment, global expected influence was 24.74 for the male group and 23.92 for the female group. Among the children who received the Full Risk Assessment, it was 108.40 for the male group and 107.90 of the female group.

These differences could in part be due to the unequal sample sizes across the groups, as the power to detect an edge is higher in groups involving a larger sample. Nevertheless, the results still indicate that the differences in global expected influence between the groups of children who received the Brief Risk Assessment were statistically significant ($S = 5.31$, $p = 0.014$). However, the differences were statistically unsignificant in the groups of children who received the CAMHS New Risk Assessment ($S = 0.81$, $p = 0.13$) and those who received the Full Risk Assessment ($S = 0.51$, $p = 0.94$). Furthermore, the omnibus test on network structure invariance was conducted to investigate the differences in edge weights between genders. Results indicated significant differences between the edges of these networks: $M = 1.03$, $p = 0.004$ between the groups of children who received the Brief Risk Assessment, $M = 0.68$, $p = 0.003$ between groups of children who received the CAMHS New Risk Assessment, $M = 2.17$, $p = 0.03$ between groups of children who received the Full Risk Assessment. Together, these results indicate considerable change in the network structure across genders.

4. Discussion

In this study, we applied network analysis to different risk assessment groups of children and adolescents over 10 years in the UK to reveal the structure of early risks of children and adolescents, as well as the differences between genders. Our findings reveal stable connections across genders in different assessments of risks (e.g., risks of self-harm and suicide). In addition, we found that risks related to violence towards others appear to be core risks in all networks, and males could be more exposed to violence-related risks compared with females. As a result, the current study sheds light on gender differences in early risks and could be of value for intervention and prevention.

4.1. Network structures in three risk assessments groups

Some notable patterns can be observed when focusing on the network connections across risk assessments, and these connections indicate the associations among the different risks. Most positive connections occur in the same or similar aspects of risks. For instance,

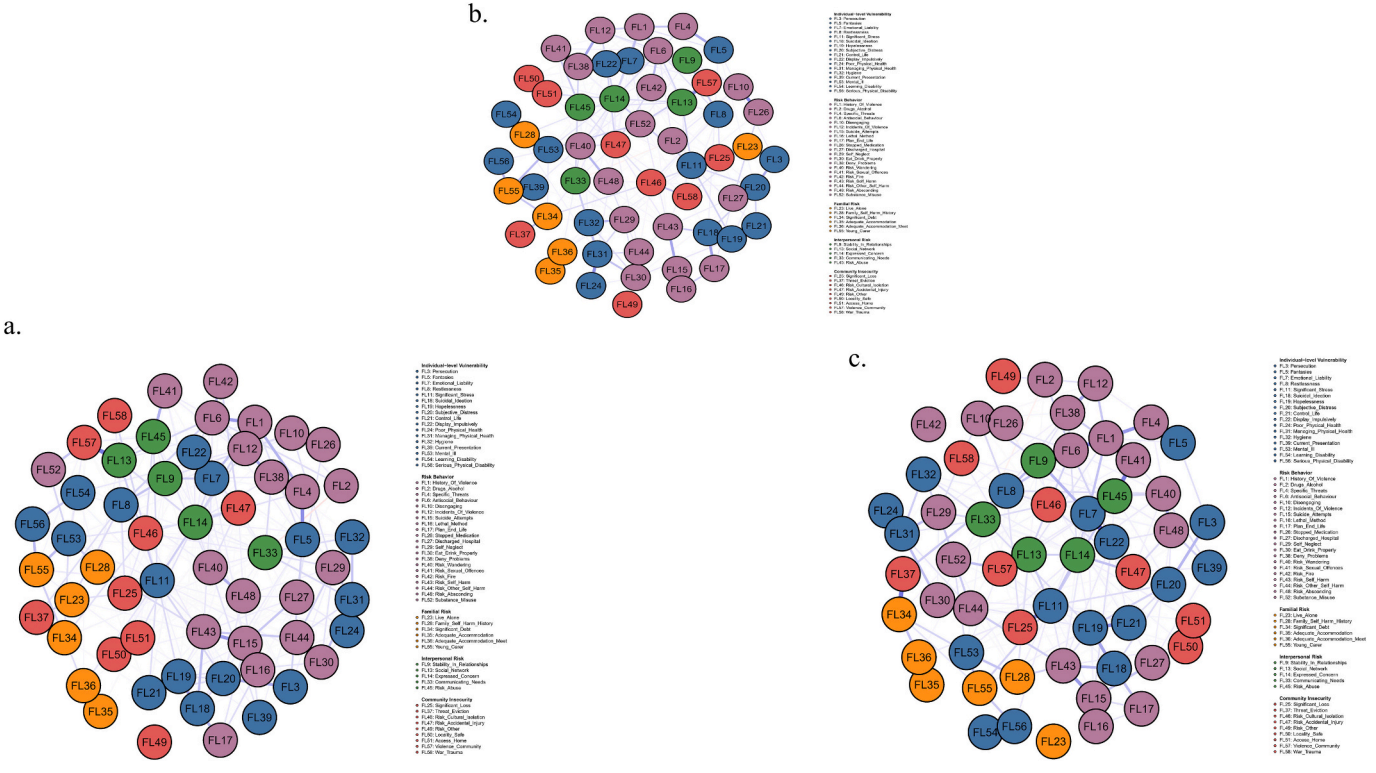

Fig. 4. Networks of the group of children who received the Full Risk Assessment. Blue lines represent positive associations, red lines represent negative ones, and the thickness and brightness of an edge indicate the association strength. a. Network of overall group of children who received the Full Risk Assessment ($N = 4669$). b. Network of male subgroup ($N = 2436$). c. Network of female subgroup ($N = 2233$). Detailed description of risks can be found in Table S1 in supplementary. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

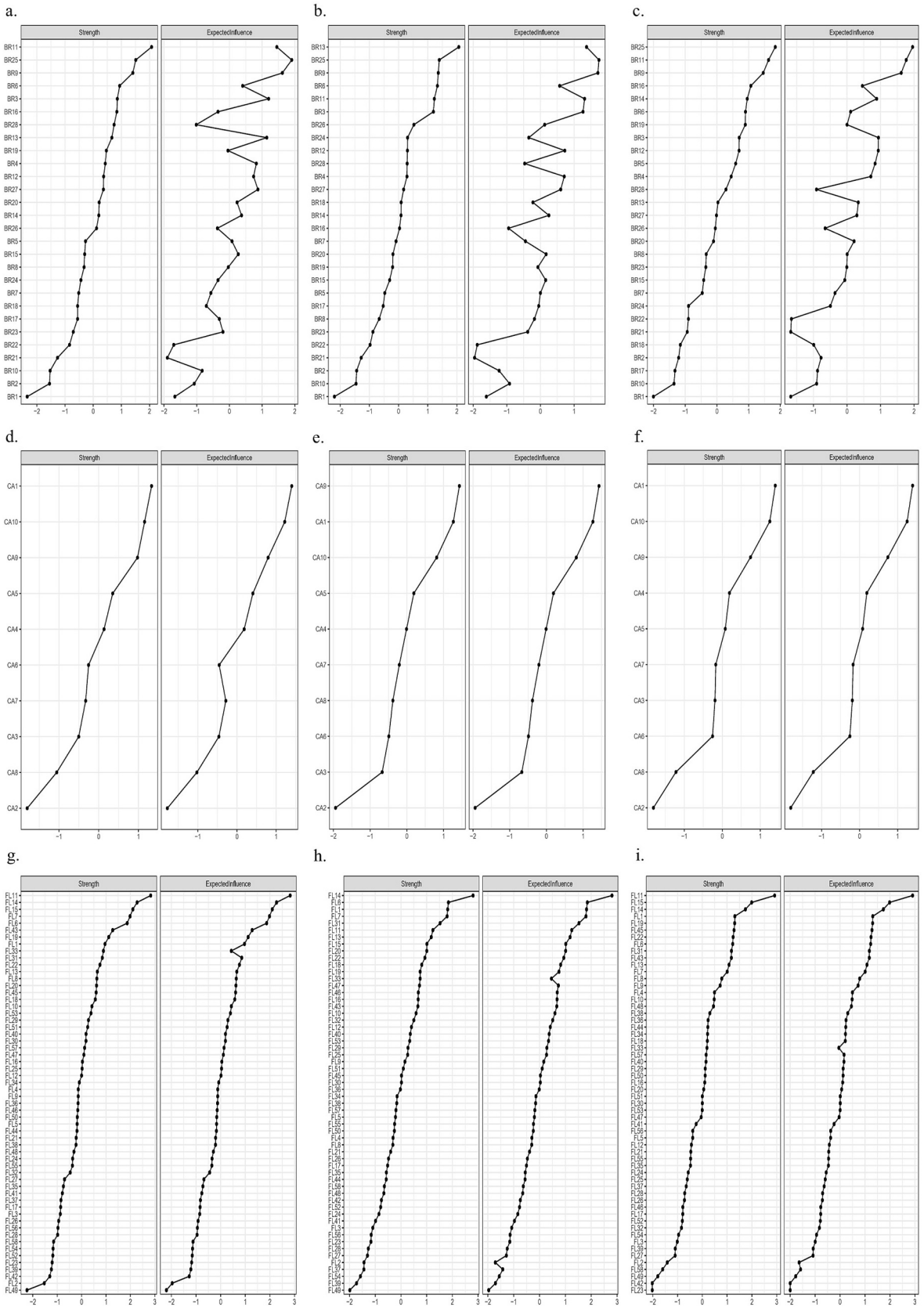

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Fig. 5. *Z*-scores of centralities across networks. a. to c. present centralities in the groups of children who received the Brief Risk Assessment, and within this group, the male subgroup and the female subgroup respectively. Similarly, d. to f. show centralities in the groups of children who received the CAMHS New Risk Assessment and g. to i. indicate centralities in the groups of children who received the Full Risk Assessment.

risky behaviors are positively associated in all three risk assessment groups: BR11 (violence towards others) and BR15 (physical abuse to others) in the overall group of children who received the Brief Risk Assessment, CA6 (self-harm) and CA7 (suicide) in those who received the CAMHS New Risk Assessment and FL15 (suicide attempt) and FL43 (Risk_Self_Harm) in those who received the Full Risk Assessment.

Apart from relatively consistent risks, there were some positive edges in different aspects of risks (e.g., interpersonal risk and risky behavior). For example, associations between risks of violence to and from others also exist in the three groups: BR5 (sexual abuse from others) and BR17 (sexual abuse to others) in the overall group of children who received the Brief Risk Assessment, and CA9 (violence to others) and CA10 (violence from others) in overall group of children who received the CAMHS New Risk Assessment. Such findings are in line with the 'cycle of abuse' and 'cycle of violence' theories that a victim of abuse could later go on to offend (Widom, 1989; Zhang et al., 2025). This complex cycle has different potential explanations. For example, Tedeschi and Felson discussed the mechanisms that may promote the intergenerational transmission of violence based on social learning theory (Tedeschi & Felson, 1994), and Crittenden and Ainsworth argued that trust in others may impact the likelihood of maltreated children engaging in subsequent violence based on attachment theory (Crittenden & Ainsworth, 1989). Apart from positive connections, items in these two categories could also be negatively associated. For example, FL2 (drug or alcohol misuse) and FL33 (difficulty communicating needs) are negatively associated among those who received the Full Risk Assessment. It could be explained that the misuse of drugs or alcohol could associate with social isolation (Le et al., 2021; Walker et al., 2022), which could reduce communication of needs.

The centralities of networks across risk assessments also have something in common. Among the three risk groups, risks within risky behaviors have strong strength centrality: BR11 (physical abuse to others) in those who received the Brief Risk Assessment, CA9 (violence towards others) in CAMHS New Risk Assessment group, and FL6 (antisocial behavior) in the Full Risk Assessment group. When a risk has the highest strength centrality, this means it is strongly associated (both positively and negatively) with all the other risks. The strong strength centrality for risks related to 'violence towards others' could be because a number of early risks and events are associated with child and adolescent development of violent and antisocial behavior (van Goozen et al., 2022). Thus, someone exhibiting violent behaviors might be likely to experience more risks, and this contributes to the high centrality of such nodes.

Despite similarities, Full Risk Assessment group has higher centrality in individual-level vulnerability risk. For example, FL11 (significant_stress) has higher centralities than FL6 (antisocial behavior). As the Full Risk Assessment groups had been identified as higher risk by clinicians, they might have more severe mental health issues than the others. As a result, FL15 (suicide_attempts) also has a strong centrality in the group. Though the comparability between groups could be limited due to the different items across assessments, it is still worth noting that people who took Full Risk Assessment might need more intervention on individual risks rather than violent behavior towards others. While in the Brief Risk Assessment group, BR25 (risk-taking behavior) is also a node with strong centrality. This could be explained by findings that adverse socioeconomic status, environment and personal experience could all contribute to shaping the risk-taking behavior of adolescents (Armstrong-Carter et al., 2025; Ciranka & Hertwig, 2023). What's more, the culture of violence (living in a violent environment or receiving lots of information about violence) plays an important role. It's been widely discussed that the culture of violence could contribute to various kinds of adverse outcomes, such as violent behavior and self-harm (Karhausen, 2025). Based on the discussion above, we argue that risks related to violence could be a core cluster in the risk networks. As a result, more attention should be paid to the environment that children and adolescents grow up in (Coughlan et al., 2024). Given the nature that environment may not always be under control, additional intervention points could also focus on how to make children feel secure and how to lead them to cope with violent environment and information.

4.2. Similarities and differences between genders

Most of the edges in subgroups present similarly to those in overall risk assessment groups. For example, CA6 (self-harm) and CA7 (suicide) have the strongest positive association within all CAMHS risk networks. However, there are also some differences between genders across risk assessments. According to the results of network comparison, the statistical significance of global expected influence is only present in Brief Risk Assessment subgroups, while all the comparison groups have statistical significance of edge differences, which indicate considerable differences among edges across genders. For example, BR13 (offending others) and BR19 (substance misuse) are more closely associated in male subgroup of children that took the Brief Risk Assessment, and FL42 (sexual offences) and FL46 (abuse) are more closely related in the female subgroup of children that took the Full Risk Assessment.

These differences are also explainable: males may be more likely to develop substance misuse, as well as exhibit more violent or offending behavior (van Goozen et al., 2022; Walker et al., 2022). This may reflect gender performativity, which suggests that social context, rather than inherent gender differences, drives gendered behavior (Butler, 1988). And females could be more likely to experience abuse, especially sexual abuse (Tian et al., 2024; Winstanley et al., 2020). There are three different potential reasons: females could have been socialized to be more compliant and responsive to the needs of others, which may result in higher levels of abuse victimization, or males could have been socialized to be more abusive, resulting in more women victims (Wellman, 1993). Another reason is that different prevalence rates may be due to possible underreporting of sexual abuse victimization by males, which may not be the case for neglect and physical abuse (Winstanley et al., 2020). All explanations are in line with Butler's theory of gender performativity (Butler, 1988).

The closer connections in one gender group do not deny the same connections in the other. For centralities, though BR9 (culture of violence) retains its strength in both genders, BR11 (violence towards others) is replaced by BR13 (offending others) in the male subgroup and BR25 (risk-taking behavior) in the female subgroup. These findings highlight that exposure to a violent environment or information could be associated with other risks. What's more, the difference between two genders reveals that when under risks and high pressure, males could behave slightly more aggressively compared with females (Ciranka & Hertwig, 2023; Karhausen, 2025). Even so, risk-taking behavior still has strong centrality in both subgroups. Similarly, CA9 (violence towards others) becomes the strongest node in the CAMHS New Risk Assessment male subgroup compared with the female subgroup. Also, of the children who received the Full Risk Assessment, FL6 (antisocial behavior) and FL1 (history of violence) present stronger centralities in the male subgroup, whereas FL11 (significant stress) and FL15 (suicide attempts) do so in female subgroup. As discussed above, this could be because various early risks and events are associated with the development of violent and antisocial behavior of children and adolescents (van Goozen et al., 2022). Thus, a child that exhibits violent behaviors could be likely to experience more risks, which then contributes to the high centrality of such nodes. On the other hand, it might be associated with previous findings that females could have higher rates of internalizing symptoms, which could make them sensitive to stress, as well as to developing more self-harm or suicide behaviors (Keyes & Platt, 2024).

In summary, our study highlights the connections between risks, which are beneficial for both discovering and understanding risks. Based on results of centralities, interpersonal violence plays an important role in all the networks, especially for male groups. In addition, combining results of connections between risks and centralities, a culture of violence and self-awareness could play essential roles in early risks, indicating that the external environment around children (e.g., the community) and the self-awareness of the children are also vital (Finkelhor, 2018; Laake et al., 2025).

All the results and discussions in this study are based on records from clinical service. To a large extent, this data indicates how the service works and how the clinicians record the cases. However, it still could not fully equal the complex lives of children and adolescents. Also, it should be acknowledged that the early risk network could be buffered by some potential protective factors like social support (Lin et al., 2022). Thus, all the results and discussions should be interpreted cautiously, and further research is still needed.

5. Limitations and implications

Our study should be seen in light of several limitations. First, the risks derived from clinical data may not be equal to the complex lives of children and adolescents. Additionally, the items are different across three risk assessments, which limited the comparability. The number and homogeneity of items might also inflate the centrality estimation. Second, current analysis is based on the first assessment for each young person. As the nature of risks is dynamic, one fixed time point may result in losing some information. Further analyses using longitudinal CRIS data could provide stronger causal insights into the dynamic interplay among risks over time. Third, though the current study is based on a large cohort of children and adolescents in the UK, the risk assessments blended historical and contemporaneous risk items, which makes it unclear whether a particular risk truly causes the occurrence of another risk in the network. Fourth, the extracted data did not have data on gender minorities, which limited the gender differences between male and female. Also, other social factors (e.g., races) are not included, which means it lacks intersectional enquiry. Finally, network analysis applied to pooled data allows for conclusions about associations between risks at the population level rather than causal relationship between risks at the individual level. Also, the estimated associations between edges are not directed, which further limits conclusions regarding the direction of any causal effects. Thus, based on our findings and limitations, future study could record risks more precisely, utilize data from multiple time points and take more social-demographic factors into consideration to obtain integrated and comprehensive results.

Despite the limitations, our study has potential strengths and implications. One major strength is that the current data is drawn from a large clinical cohort of children and adolescents across 10 years in the UK. As a result, the risk assessments were completed by the supervision of clinicians rather than self-report questionnaires, which enhances the validity and reliability of the risk assessments (Lee et al., 2020). Also, the advent of electronic health records offers access to large databases that better reflect routine clinical workflows, potentially reducing the ‘translation gap’ between model development/validation and implementation that frequently limits real-world application (Lee et al., 2020). The second strength is that our assessments of risks contain lots of items beyond ACEs (e.g., culture of violence), which could be a supplement to the field of early adverse experiences of children and adolescents. Another major strength is that our network analysis indicated key associations among risks and identified a set of core risks across genders, which may have implications for prevention and intervention.

Our study has various implications for future intervention. First, as a supplement to traditional ACEs, our study indicates that interpersonal and community-level risks are also essential. Thus, future intervention should not be limited to the family and the behavior – the external environment around children (e.g., the community) is also vital (Cronholm et al., 2015; Finkelhor, 2018; Laake et al., 2025). Second, the connections between risks shed light on both discovering and understanding risks. One risk could be a clue to other risks associated with it. For example, when one young person reports substance misuse, it might be necessary to assess their offending behavior within CAMHS. What's more, some negative connections provide new insights into understating risks. For example, the negative connection between FL2 (drug or alcohol misuse) and FL33 (difficulty communicating needs) reveals that substance misuse could associate with social isolation (Le et al., 2021; Walker et al., 2022), which involves the reduction of communication with others. Third, based on results of centralities, interpersonal violence plays an important role in all the networks, especially for male groups. Though the existing risks cannot be changed, interventions that prevent violent behavior are not only beneficial for individuals, but also for the people around them, especially for people who have already behaved aggressively.

6. Conclusion

This study applies network analysis to offer a holistic account of early risks among children and adolescents over 10 years in the UK. Our findings reveal stable connections across genders in different assessments of risks (e.g., risks of self-harm and suicide). Given little attention towards the associations both within risks and of risks across genders, this study identifies considerable gender differences. As one risk could be a clue to other risks associated with it, such differences could be of value for both prevention and intervention. For example, when one young male person reports substance misuse, it might be necessary to assess their offending behavior within CAMHS. In addition, risks related to violence and self-awareness could play essential roles in early risks, indicating the external environment around children (e.g., the community) and the self-awareness of the children are also vital in clinical practice and policy making.

CRediT authorship contribution statement

Fan Yang: Writing – review & editing, Writing – original draft, Visualization, Methodology, Investigation. **Robbie Duschinsky:** Writing – review & editing, Supervision, Resources, Project administration, Methodology, Funding acquisition. **Laura Mucha:** Writing – review & editing. **Fabienee Dos Santos Sousa:** Writing – review & editing, Methodology. **Matt Woolgar:** Writing – review & editing, Methodology. **Tessa Morgan:** Writing – review & editing. **Nicole Marshall:** Writing – review & editing. **Julia Mannes:** Writing – review & editing. **Dihini Pilimatalawwe:** Writing – review & editing. **Anna Moore:** Writing – review & editing. **Barry Coughlan:** Writing – review & editing, Supervision, Project administration, Methodology.

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Declaration of competing interest

None.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.chiabu.2026.107941.

Data availability

The authors do not have permission to share data.

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