

Breaking networks of youth serious violence

Evidence from Cambridgeshire

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Final Report

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Executive Summary

This study investigates the relational risk factors linked to youth violence — including both suspected offending and victimisation. Moving beyond individual-level analysis, it places (social) relationships at the centre of inquiry by examining how network structures and a person's position within those networks shape the risk of violence. This research focuses on the relational behaviour of an *at-risk youth population*, i.e., individuals already known to the police as suspects in any type of crime, rather than the population of all young people. Comparisons made in the study are mostly within a group identified and recorded by the police because of an alleged connection to crime. The one exception is the youth victimisation analysis where, in some cases, we also include individuals recorded exclusively as victims throughout the entire period. This group of young individuals at higher risk is central to efforts to develop targeted, network-informed interventions aimed at reducing youth serious violence.

The study draws on administrative records provided by Cambridgeshire Constabulary covering the period from March 2018 to October 2021. It examines the characteristics, behaviours, and relational dynamics of individuals aged 18 or under who were involved in crime events as suspects, victims or both (in separate events). The records include 14,408 individuals classified as young people (aged 10–18), of whom 6,000 were suspected of committing at least one offence of any type. This latter group, considered to be at heightened risk, forms the primary focus of the analysis. It should be noted that our classification of youth includes individuals who had turned 18, as risk exposure, network involvement and their consequences do not always align neatly with the legal threshold that separates youth from adult justice; however, we recognise that the criminal justice system treats 18 as the point at which youth jurisdiction ends.

Key Findings

Violent offending

1. **42% of youth suspects were recorded alongside at least one other person in a crime event of any type** (i.e. suspected co-participation in a crime event). These networked (connected) individuals are associated with considerably higher rates of knife involvement (2.5 times), and links to organised crime groups (7.5 times) compared to those who acted alone.
2. The **most connected youth** (top 5% by number of co-suspects, i.e. degree centrality) are almost five times more likely to carry a knife and almost three times more likely to be involved in violent crime than the broader youth suspect population.
3. **Being connected to a suspect of any crime type increases the odds of violent behaviour.** Each co-suspect increases the odds of violent behaviour by around 30% and knife violence by 19%.
4. **Being close in the network to a suspect of any crime that is also a victim of violence** increases the probability of committing violence — by about 9% for general violence and 15% for knife violence.
5. **Youth suspected of knife violence** are 2.6 times more likely to be involved in **drug-related crime** and 8.2 times more likely to be linked to an **organised crime group** (OCG) than a youth suspect generally.

Violent victimisation

6. **Being connected in the network to a suspect of any crime increases the odds of violent victimisation.** Each co-suspect increases such odds by roughly 7% for general violence and 11% for knife-related violence.
7. Being close in the network to a suspect of any crime that is also a **victim of violence** raises knife victimisation odds by nearly 17%.
8. Among youth victims, the **victim–suspect overlap grows sharply with crime severity**: 22% of victims in entire youth victim population were also recorded as suspects in another crime event, the rises to 35% for victims of violence with injury; 41% for knife-related victims and nearly 60% for victims of knife violence.
9. **Victims of more severe violence are embedded in riskier networks.** The share of individuals connected to at least one knife-flagged co-suspect rises from 23% among victims of non-violent crime, to 38% among violence victims, and to 64% among victims of knife-related violence.
10. **Violence between young people mostly occurs among individuals with a similar profile** — same age group (68%), same gender (70%), and same ethnicity (83%). *However, about a third of victim/offender pairs involve adults and youth, requiring distinct safeguarding responses.* Same-gender patterns also mean female-on-female violence is a notable component, often overlooked in male-focused prevention strategies. Organised crime members, though rare, are 3.5 times more likely to be suspects than victims.

Youth Suspects

1. Demographic and Offending Profiles

Over the study period, 6,000 young individuals were identified as suspects of any crime (68% male), 1,461 of violence, and 139 of violence with a knife. The gender balance is relatively consistent across violent and non-violent suspects, though the subset involved in knife violence is overwhelmingly male (88.5%). Within the knife violence subset, Black individuals are over-represented relative to the broader youth suspect population. No other significant demographic differences emerge for the remaining categories.

Young people suspected of violence with a knife are 2.6 times more likely than the general youth suspect population to be involved in drug-related criminal activity, and 8.2 times more likely to be identified as members of an organised crime group (OCG) than the general youth suspect population. These patterns indicate that knife violence is associated with a distinct and heightened risk profile that includes drug involvement and membership in predominantly adult organised crime groups.

2. Co-Suspect Networks

A central contribution of this study is the construction and analysis of co-suspect networks among at-risk youth in Cambridgeshire. Of the 6,000 youth suspects, 42.2% were recorded as having been involved in at least one crime event alongside another individual of any age, while 57.8% appeared only as solo suspects. The broader co-suspect network comprises 9,043 individuals (2,533 youth and 6,510 adults), with an average of 2.14 connections per individual (of any age). Within the network's largest connected component, which includes 13% of all nodes (1,177 individuals), youth tend to cluster together. However, notable exceptions exist where young people are embedded within predominantly adult sub-networks. These youth–adult network configurations raise important concerns about exposure to more developed criminal knowledge and social learning processes that may reinforce offending behaviour. Additionally, age differences create power imbalances that may leave young people vulnerable to manipulation, coercion, or exploitation by adult suspects, potentially shaping longer-term criminal pathways and reducing prospects for moving away from crime.

The networked subset of young suspects differs substantially from solo suspects in ways that carry important implications. Networked individuals (i.e., individuals connected to at least another suspect) are 8.6 times more likely to have been involved in robbery, 3.1 times more likely to have been involved in theft or burglary, 1.23 times more likely to be connected to drug-related offences, 2.46 times more likely to be suspects in knife-flagged events, and 7.5 times more likely to be associated with an organised crime group. These findings suggest that suspected co-participation in crime is a meaningful and distinct marker of elevated risk.

3. Spatial Patterns: The Locality of Youth Violence

The geographic analysis shows that youth violence is predominantly local and **urbanised** in nature. Considering four macro-areas within Cambridgeshire (Peterborough, Cambridge, Huntingdonshire and Fenland), 91.7% of youth suspects committed violent offences in a single macro area, with just 6.8% active in two areas and only 1.5% in three or more. Even for knife-related violence, which is somewhat more geographically spread out, 83.7% of suspects operated within a single area. The co-suspect network mirrors this spatial concentration, with suspects from Peterborough, Cambridge, and Fenland forming distinct clusters of suspected co-participation in violent events, and cross-area ties remaining limited.

4. Network Position and Violence Risk

The study reveals a clear and statistically significant association between an individual's position within the co-suspect network and their involvement in violence. Degree centrality, which captures the number of co-suspect connections, shows that youth suspected of violence have significantly more connections than those suspected of other (non-violent) offence types (an average of 3.18 versus 2.26).

An important finding is that among the top 5% most connected youth (208 individuals), 65% had been involved in a violent offence, 37.5% had been flagged for carrying a knife, and 42.8% were involved in drug-related offences — far exceeding the rates in the broader youth suspect population of 24%, 8%, and 17% respectively. These highly connected youth are also predominantly male (87.5% versus 68% overall) and more likely to be linked to organised crime groups. These differences are statistically significant. These findings show that network structure matters and point to the importance of identifying and prioritising highly connected and centrally positioned young people for interventions, as they represent a particularly high-risk group within an already at-risk population.

5. Relational Risk Factors

The analysis goes beyond individual characteristics to examine how the attributes of co-suspect connections relate to violent behaviour. As the severity of violence increases, so does the proportion of individuals connected to individuals flagged for drug activity or acquisitive crime. Among youth involved in knife-related violence, 67% are connected to drug-involved individuals (versus 31% overall). Crucially, the study moves beyond direct co-suspect connection by introducing a network proximity measure based on shortest-path distances. This distance captures the minimum number of network steps linking a suspect to someone involved in a specific type of crime (i.e., both direct and indirect exposure to specific crime types). Each network step represents one person: for example, being two steps away means being connected to someone who is themselves directly connected to a person involved in that specific crime type (direct connections are one step away).

Crucially, whether a young person suspected of any crime was involved in a wider network of connections or not played a significant role in their risk of committing violence, with each co-suspect increasing the odds of violent behaviour by around 30%. For young people embedded in networks of suspected criminal connections, being close to someone who is both a suspect of any crime and a victim of violence increases the odds of committing violence by around 9%. Proximity to individuals involved in robbery or organised crime further raises the risk of violence among young people embedded in networks.

Knife-related violence presents a similar pattern with each co-suspect increasing the odds of knife violence by around 19%. Among young people embedded in networks of suspected criminal connections, being close in the network to a victim of violence with injury raises the odds of knife violence by 15%. Proximity to robbery-involved, drug-involved, or theft/burglary-involved co-suspects further raises risk. Unlike for general violence with injury, gender (being male) and ethnicity (being of Black ethnicity) emerge as significant predictors for knife-related violence.

Crucially, for individuals without network ties, no individual or offending characteristics have the effect of increasing the risk of either form of violence, underscoring that network participation itself is a key driver of violence risk rather than the type of offence alone.

Youth Victims

The study also examines the characteristics, relational dynamics, and risk factors associated with violent victimisation among individuals aged 10 to 18. It distinguishes between two key groups: young people who have been recorded solely as victims ('victim-only') and those who have also been recorded as suspects in separate crime events ('victim-suspect').

6. Prevalence and the Victim–Suspect Overlap

Over the study period, 10,491 young individuals were recorded as victims of at least one crime. The majority (78%) were recorded solely as victims, while 22% were also identified as suspects in separate offences. Among the 1,968 youth victims of violence specifically, the victim–suspect overlap rises to approximately one-third. This overlap grows further with crime seriousness: 41% of knife-related victims and nearly 60% of victims of knife-related violence with injury were also recorded as suspects.

Gender differences widen as violence severity increases. While males make up 54.1% of all victims, their share reaches 87.4% among victims of knife-related violence. White victims remain the largest group across all categories; however, individuals from minority ethnic backgrounds become increasingly represented in knife-related categories. Youth with links to organised crime groups are rare among victims overall but disproportionately represented in

knife-related violence, being 6.5 times more likely to be victims of knife violence than of violence with injury generally, and 13 times more likely than to be victims of crime of any type.

7. The Victimisation Network

The youth violent victimisation network, linking youth victims to suspects of any age, comprises 2,285 individuals. Each suspect has victimised an average of 1.19 victims, while each victim has been victimised by an average of 1.38 suspects, with maximum values reaching 8 and 10, respectively. When violence is repeated, it typically involves different suspects rather than the same individual, contrasting sharply with patterns typically observed in adult intimate partner violence.

8. Victimisation and Offending Network Exposure

The study examines the relational patterns of youth victims who have also been recorded as suspects, assessing whether exposure to risky networks differs systematically by type of victimisation. Relational patterns (networks) are built based on suspected co-participation in crime events. A clear pattern of escalation emerges: victims of more severe violence are disproportionately connected to co-suspects with elevated risk profiles, including higher probabilities of being male, being in possession of a knife, and being involved in violent or criminal activity. The proportion of individuals connected to at least one co-suspect flagged for knife possession increases from 23.1% among victims of non-violent crime, to 38.1% among victims of violence, and to 64.4% among victims of knife-related violence. These findings indicate that severe victimisation is associated with being embedded in networks characterised by concentrated risk.

Proximity score analysis, based on shortest-path network distances, shows that individuals are on average more closely connected to victims of general violence than to victims of knife violence, suggesting that knife-related victimisation is concentrated within more tightly bounded, high-risk segments of the network.

9. What Drives Victimisation?

Regression models estimated on the entire at-risk youth population, which include both networked and non-networked individuals, reveal that violent victimisation is shaped by both individual offending behaviour and network embeddedness, i.e. the level of connections that a person possesses. Each co-suspect increases the odds of violent victimisation by roughly 7% and knife violent victimisation by 11%.

Among young people embedded in networks of suspected criminal connections, being close in the network to a victim of violence with injury raises the odds of violent victimisation by 16%

and knife victimisation by nearly 17%, consistent with the idea that victimisation clusters among at-risk populations exposed to similar risky environments.

Among the same networked individuals, proximity to organised crime members and to individuals involved in drug-related activities and robbery further increases risk of violent victimisation by 2.5%, 3% and 5%, respectively. For knife-related victimisation, these patterns are even more pronounced, with effects rising to 11.5% for proximity to drug-related activities and 14% to robbery.

Among non-networked individuals, most predictors are not statistically significant, further underscoring the central role of network embeddedness.

10. The Shared Profile of Suspects and Victims in Violent Events

Analysis of suspect–victim pairs reveals strong similarity (homophily) across multiple dimensions. Age similarity is pronounced, with 68.2% of pairs involving individuals in the same age group. Gender similarity is also strong, with 70% of violent pairs occurring between individuals of the same gender, rising to approximately 80% among youth-only suspects. Ethnic similarity is particularly marked, with 83% of pairs involving suspects and victims of the same ethnicity. Although organised crime members are rare in the violence network, when present, they are 3.5 times more likely to occupy the suspect rather than victim role, suggesting that targeting organised crime members may have an outsized impact on violence dynamics.

11. Limitations

The cross-sectional design cannot establish the direction of effects, and police event data only partially capture young individuals' daily experiences. Additionally, the dataset is limited to individuals who have come to police attention, meaning it does not capture the full universe of victims and offenders — and the composition of the network to some extent also reflects police activity.

Further work should be carried out to understand the motivations underpinning the use of violence, and to ascertain whether more violence-inclined young people are more likely to become embedded in networks of offending or at-risk subcultures (thus exploring the potential reverse causality mechanism) through longitudinal quantitative designs and qualitative interviews with affected individuals and practitioners.

Finally, this study covers a single force area, and caution should be exercised when generalising findings. It remains an open question whether network dynamics would differ in larger urban settings such as London or Birmingham, and future work should replicate our analysis in other settings. Nonetheless, we remain confident that the core mechanisms and key conclusions are not specific to Cambridgeshire, and there is nothing to suggest the area is atypical in this respect. The exception concerns findings related to ethnicity, which tend to be highly context-specific and should not be generalised beyond the local setting.

Implications for policy and practice

The following network-informed strategies are relevant to both the prevention of youth violent offending and the reduction of youth violent victimisation:

1. Intervening at the first signs of **network embeddedness, regardless of offence seriousness**.
2. Adding **network-based factors to risk scoring tools** based on either direct connections (degree centrality) or network proximity to high-risk individuals.
3. Prioritising high-degree '**super-connected**' youth for intervention programs.
4. Targeting proximity to specific suspects within networks (e.g. organised crime or robberies) to **disrupt particularly harmful exposure**.
5. Identifying young people connected to **suspects who have also been victims of violence**, whether peers or adults, offers opportunities for early intervention.
6. Special attention should be paid to **age gaps** in co-suspects relationships, as these may expose young people to more serious criminal activity and violence.
7. Importance of focusing on the **drug-knife-violence nexus**.

For youth violent victimisation, the study additionally suggests:

8. Breaking down institutional separations between 'victim' and 'suspect' within at-risk youth with an integrated case management approach, as **victim-offender overlap** grows sharply with crime severity.
9. Recognising that **proximity to a victim of violence** is a strong risk factor for knife victimisation **among youth who have also been a suspect in an unrelated event**.
10. Adopting **network-aware knife violence strategies**, as knife violence victimisation is **disproportionately concentrated** among youth suspects embedded in co-suspect networks.
11. Peer-group interventions should be designed reflecting **same-gender dynamics**. Male-focused programmes are certainly crucial, but the substantial level of female-on-female violence should not be overlooked.
12. Developing a distinct response for **adult-on-youth violence**. One-third of violent pairs involving adult suspects victimising youth likely reflects different dynamics compared to youth-on-youth violence — potentially including exploitation.
13. Targeting **OCG members as drivers of violence**. Although OCG-linked individuals are a small group, they are disproportionately in the perpetrator role.
14. Tracking changes in **network position as an outcome measure** to assess whether interventions successfully reduce an individual's network embeddedness (level of connectivity) as a way to decrease the risk of future victimisation.

Finally, it is suggested to build capacity around:

15. Systematic data collection and **network mapping capabilities** not only within police but also within youth services to inform proactive intervention before violence occurs.

16. Develop safe, proportionate, and ethical **procedures to share network intelligence** across criminal justice agencies, youth services, the education sector, and community organisations. Multi-agency responses should draw on multiple sources of information about individuals' network exposure and position.

While the analysis is limited to police-recorded crime events, the network-informed approach discussed in this study can also be applied by youth services and other agencies beyond the police to support the prevention of youth involvement in violence.

1. Project Objectives

Violence and knife crime involving young people have increased significantly in the United Kingdom in recent years (Youth Endowment Fund 2025; Youth Justice Board 2025a; Youth Justice Board 2025b), making it an issue of major public concern.

This project seeks to better understand violence patterns among youth, and particularly the relational risk factors associated with youth violence. The goal is to produce robust, evidence-based and actionable insights on the risk factors for engaging in both general and knife-related violence as well as for violent and knife victimisation.

This project is based on the premise that while individual (micro) and community (macro) risk factors are important, they only tell part of the story. Crucially, factors at the relational level — who is connected with whom, and why—remain understudied in violence research. This project shifts the focus from examining individuals in isolation to placing relations at the centre of analysis.

This approach builds on research into peer effects among adolescents, which has demonstrated that exposure to violence within one's peer network increases the risk of involvement in serious violence (Hayne et al. 2006). Adolescents whose friends have previously engaged in serious fighting, caused severe injuries, or used weapons are themselves more likely to exhibit these behaviours (Bond and Bushman 2017). Similarly, Brennan (2019) found that having "more than a few" peers in trouble with the police was associated with self-reported weapon carrying among young people aged up to 25. While this peer effects literature establishes the importance of social connections, the present study extends previous research by employing formal network analysis techniques to model relational factors and by considering effects beyond direct peer connections, looking at the whole network of connections, to understand how the structure of such networks as well as the individual position within them shape patterns of violence involvement and victimisation among youth.

Additionally, while such studies tend to look at peer effects among the general (adolescent) population, we explore a separate set of questions related to the emergence of violent behaviour and the risk of violent victimisation among an *'at-risk' youth population*, i.e. individuals who already known to the police as suspects in any type of crime, rather than the population of all young people. Most comparisons made in the study are therefore within a group identified and recorded by the police because of an alleged connection to crime. The one exception is the youth victimisation analysis where, in some cases, we also include individuals recorded exclusively as victims throughout the entire period. This group of at-risk young individuals is central to efforts to develop targeted, network-informed interventions to reduce youth serious violence.

This is in line with works conducted by Papachristos and colleagues on modelling networked violence among the offending population of all ages in US cities, including Boston and Chicago (Papachristos et al. 2012; Papachristos et al. 2015; Green, Horel and Papachristos 2017).

The project overall objective is to better understand *relational risk factors* to help practitioners target their efforts in preventing young people from committing and/or being a victim of violence with injury and knife-related violence. More specifically, the project is structured around the following main research objectives:

1. Mapping the demographic and offending profiles of at-risk young people in Cambridgeshire — as both suspects and victims — and examining how these profiles, including any potential overlap between victim and offender roles, are related to different levels of violence severity.
2. Constructing and analysing the co-offending (co-suspects in our data) and victimisation networks of young people and connected adults, identifying their structural properties, key positions, and geographic spread — including clustering by individual characteristics, offending type, and locality.
3. Assessing whether structural positions within co-offending (co-suspects) networks — measured through network centrality measures — are associated with increased risk of violence and knife-related violence as well as violent and knife victimisation, and examining the characteristics of the most highly connected and bridging youth.
4. Examining whether exposure to individuals suspected of crime — through both direct ties and indirect network proximity — is related to an increased likelihood of violent offending and victimisation, analysing both exposure to co-offending in general and by considering co-suspects with specific offending profiles (e.g., involved in robbery, drugs, theft/burglary, and organised crime).
5. Examining whether indirect network exposure to victimisation is related to an increased likelihood of violent offending and victimisation.
6. Evaluating the predictive value of network-based indicators against demographic characteristics in identifying youth at risk of serious violence, and determining whether network embeddedness, i.e. an individual's level of connectedness within a network of suspects, is in itself a risk factor — independently of the specific individual offending profile.
7. Analysing suspect-victim pairs to assess the degree of similarity on age, gender, ethnicity, and organised crime affiliation, distinguishing within-group from cross-group victimisation patterns.
8. Understanding the implications of the evidence base produced for targeted, network-informed prevention and intervention strategies.

2. Methodology

This study is based on a large-scale administrative dataset provided by Cambridgeshire Constabulary, covering more than 200,000 crime events across a 42-month period from March 2018 to October 2021. The dataset includes information on recorded crime events, suspects and victims, if any.

This study employs a set of different techniques to provide a comprehensive exploration of youth serious violence from a network perspective. First, it presents a series of descriptive statistics to examine the distribution of individual-level characteristics, including age, gender, ethnicity, and organised crime membership. However, while these individual attributes provide essential context, the core analytical focus shifts to the relational dimension of offending and victimisation. Moving beyond treating individuals as isolated actors, our relational approach recognises that youth suspects are embedded within overlapping social structures shaped by patterns of criminal collaboration and violence exposure. Specifically, this study maps and analyses the co-suspect network among at-risk youth, examining both the structural properties of the network as a whole and the position of individuals within it. It models relational proximity — that is, how close individuals are to others in the network even when not directly connected — to capture indirect forms of risk exposure. It also examines the tendency of violence to cluster within specific parts of the network, and whether individuals with similar characteristics tend to be closer to one another. Finally, it incorporates a geographical dimension, mapping the spatial distribution of network activity to assess the extent to which co-suspect relationships are locally bounded.

Building the victimisation and co-suspect networks

To capture the relational dimension of youth violence, we construct and analyse two networks, each capturing different, yet complementary, angles in violence dynamics: (a) a victimization network examining young people's positions as victims within patterns of violent harm, and (b) a co-suspect network examining their positions as suspects within collaborative offending structures.

The violent victimisation network is conceived as a relational representation of violent victimisation. In this network, nodes correspond to individuals and relations connected suspects to victims indicate recorded incidents in which a suspect committed violence against a victim. Individuals of all ages are included as suspects, while we focus only on youth victims. Including suspects of all ages reflects the fact that young people are embedded in social environments that extend beyond age peers, allowing us to place youth victimisation within its broader relational context.

The second network is what the literature commonly defines as a co-offending network defined as a formal relational representation of offending collaboration. In our data, such a network is best described as a co-suspect network, as nodes represent individuals suspected by the police

to have committed a crime and connections represent instances of suspected co-offending – that is, instances in which two or more individuals are recorded as suspects in the same crime event (Campana & Varese, 2022; Baika & Campana 2020; Papachristos, Braga, et al., 2015). Although our focus is on young individuals, we crucially include both young and adults also in the co-suspect network. This best reflects social reality, i.e., the fact that youth, while often disproportionately forming social connections with other youth, are nonetheless part of broader social contexts. In this way, we are able to situate young suspects within broader networks, which is crucial as risky relational environments are shaped by interactions across different age groups, and young suspects do not operate in isolation. In other words, by considering the full (all-ages) network structure, we can capture instances in which young people interact with adults and understand the broader social context that influences their offending behaviour. Co-offending networks are known to overlap substantially with broader social networks, as co-offenders typically maintain relationships beyond their criminal activity (McGloin & Nguyen, 2014; Papachristos et al., 2015).

Analysis plan

Network analysis provides a formal framework for taking relations into account by mapping connection patterns and quantifying individuals' structural positions. We compute standard network centrality measures to assess the extent and nature of individuals' embeddedness in co-offending and victimisation networks and to position violent offenders and victims relative to the wider suspect population. Two commonly used centrality measures are degree centrality and betweenness centrality: the first captures the number of direct connections that a person possesses, while the second captures how often a given individual acts as a bridge between two others in the network (Wasserman and Faust 1994).

From the co-offending network, we derive relational variables that capture individuals' exposure to violence through their social (offending) ties. Specifically, exposure to risky behaviours is measured using the shortest-path measure (Wasserman & Faust, 1994), which captures the minimum number of network steps linking a suspect to someone involved in a specific type of crime. This measure reflects both direct and indirect social proximity to violence. The approach parallels the use of geodesic distance from gunshot victims in studies by Papachristos, Braga, and Hureau (2012) and Papachristos and Wildeman (2014), which examined the risk of gunshot victimisation among co-offenders in Boston and Chicago, respectively.

To formally assess the association between social positioning (i.e. direct and indirect exposure to risky relational environments) and violent outcomes, we estimate a series of logistic regression models with binary dependent variables indicating violent offending and violent victimisation. Rather than employing classical frequentist estimation, models are estimated within a Bayesian framework. This approach offers several advantages: it provides richer and more transparent quantification of uncertainty (Gelman et al., 1995) and improves estimation stability and robustness when dealing with correlated predictors and highly unbalanced outcomes, both common features in the study of serious violence. For all analyses, we consider

the more general category of violence with injury and knife violence separately. In the Appendix, we explore the sensitivity and specificity of social positioning indicators in identifying potential vulnerabilities, i.e., the use and receipt of violence.

A note on terminology

Throughout this report, we use the following definitions based on police-recorded data:

- **'Violence with injury'** refers to violent incidents that resulted in physical harm to the victim. This category includes: Assault with injury (assault occasioning actual bodily harm); assault with intent to cause serious harm (wounding with intent to do grievous bodily harm); kidnapping (false imprisonment), manslaughter, attempted murder, murder.
- **'Violence without injury'** refers to violent incidents where no physical harm occurred. This category mainly includes assault without injury (common assault and battery).

Both classifications reflect the police's assessment at the time of recording and use the original categorisation provided in the data.

- **'Knife violence'** refers to violent incidents involving injury where a knife was present or used, as indicated by the knife flag in police records.
- **'Knife carrying'** refers to any criminal incident where an individual was found in possession of a knife, regardless of whether violence occurred.

All knife-related classifications are based on flags attached to individual incidents in the police database.

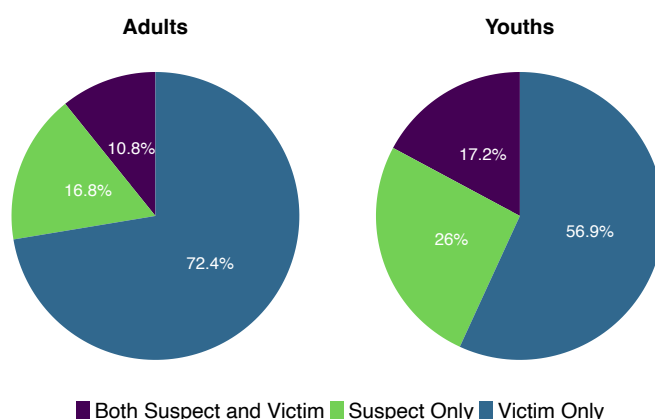
Finally, our category of **'suspect'** is based on the police assessment of an individual's involvement in a crime. This is a broad category, encompassing cases with varying outcomes in the criminal justice system — some individuals will be remanded to court, some will be found guilty, and in other cases no further action will be taken. We chose this broad category because it best approximates social reality when working from police records: our goal is to understand the relational mechanisms underpinning youth violence, not to establish guilt. This approach also has the additional benefit of producing, from police records, the closest possible picture of youth networks that social services and other non-law-enforcement agencies might observe in their work with young people.

3. Key Findings

Between March 2018 and October 2021, total of 118,158 individuals of any age were involved as suspects or victims (or both) in a crime event within the jurisdiction of Cambridgeshire Constabulary, of whom 14,408 were aged 18 or less (henceforth also labelled as ‘youth’). It should be noted that the sample includes individuals who had turned 18, as risk exposure, network involvement and their consequences do not always align neatly with the legal threshold that separates youth from adult justice; however, we recognise that the criminal justice system treats 18 as the point at which youth jurisdiction ends.¹

Among the youth population, 57% have been victims of crime at least once over the entire period (and they were never involved in a crime event as suspects during the whole period), 26% have been identified as suspects in at least one crime event (and they were never registered as victims of crime), and 17.2% have been both victims and suspects in separate crime incidents over the whole period (Figure 1). Compared with the adult population, young individuals are markedly more likely to be both suspects and victims of crime (“victim-suspect overlap”: 17.2% vs. 10.8%).

Figure 1. Distribution of individuals’ roles for youth and adult populations



Youth and adult populations in the dataset do not differ substantially in terms of gender distribution, with males forming the majority and females accounting for just under 40% in both groups (Figure 2a). When disaggregated by role, gender composition remains similar across age groups, except for a slightly higher proportion of females classified as both suspects and victims among youth (Figure 2b). Consistent with the gender patterns, ethnic distributions also do not differ substantially between the young and adult populations, except for a slightly lower proportion of White individuals and a higher proportion of “Not stated” among the youth

¹ In practical terms, this means considering 118 additional individuals suspected of committing violence at age 18 only.

population (Figure 3a). Disaggregation by role reveals no meaningful variation in ethnic composition across age groups (Figure 3b).

Figure 2. Gender distribution by (a) age group and (b) age group and role

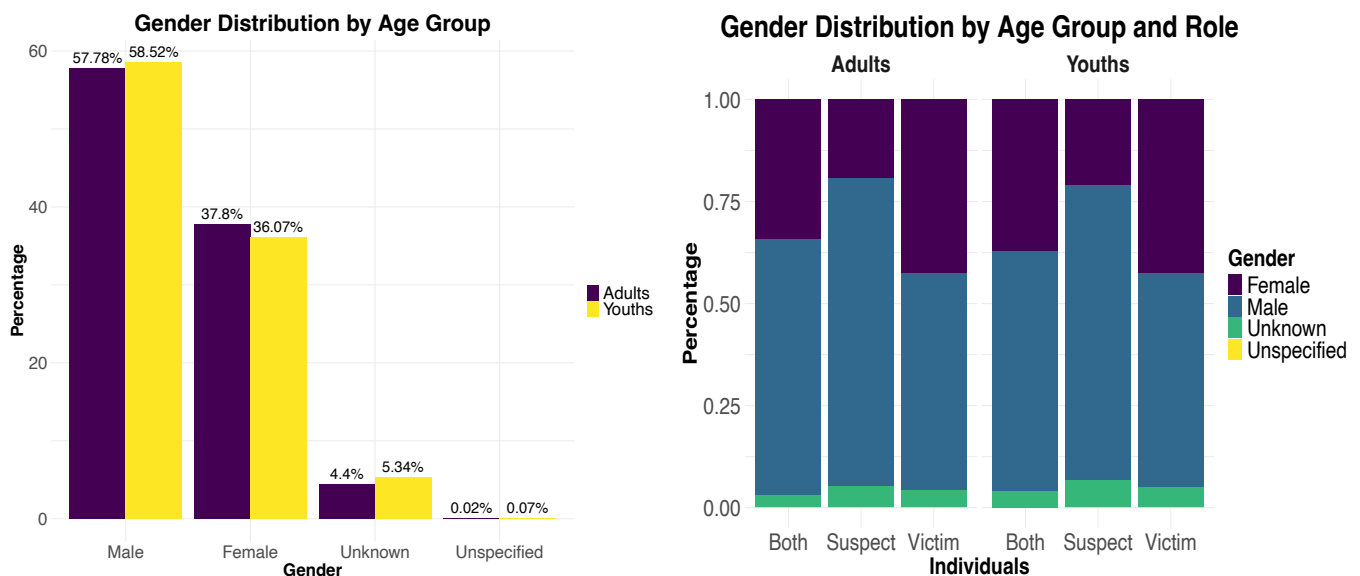
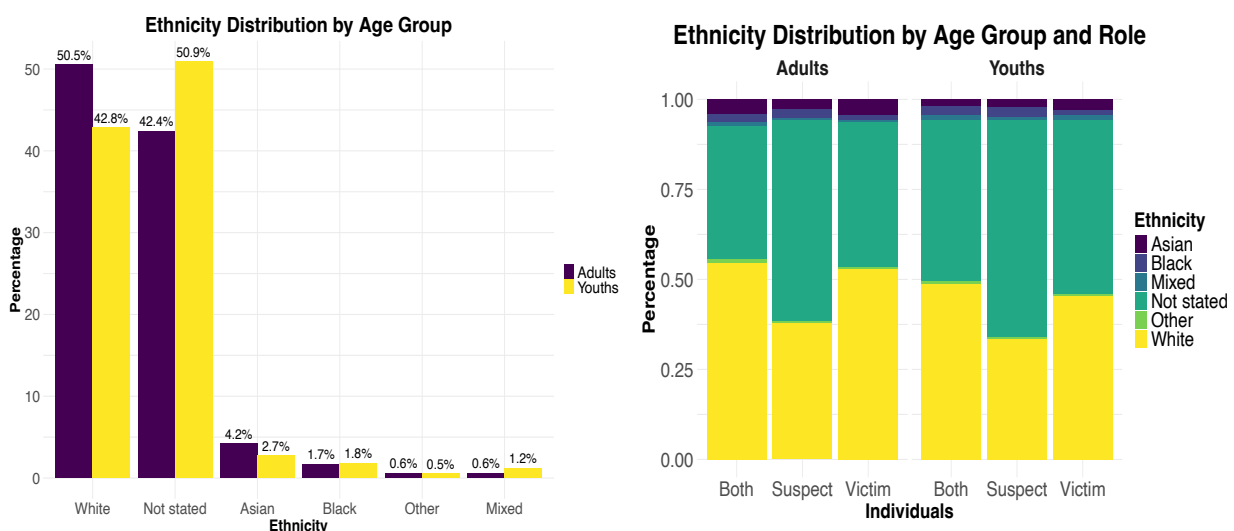


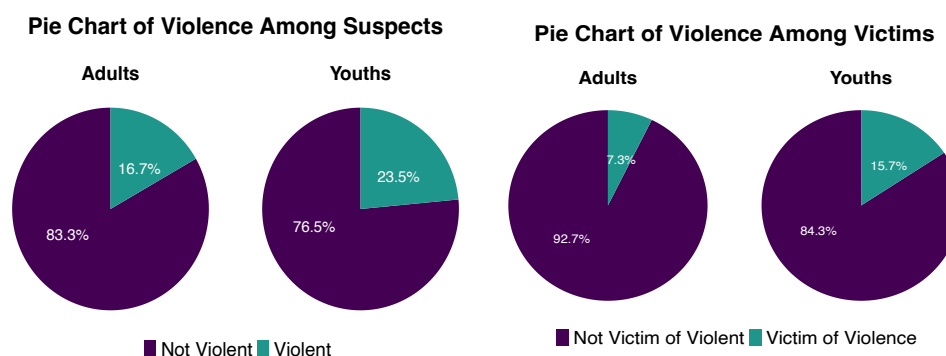
Figure 3. Ethnicity distribution by (a) age group and (b) age group and role



While adult and young populations are broadly similar in their demographic characteristics, they diverge in the role played by violence. A considerably higher share of young individuals were involved in violent events, both as a victim and as a suspect (Figure 4), with just under one in four young people in the dataset being suspected of carrying out a violent crime (compared to around one in seven adults) and 15.7% of young individuals in the dataset suffering violent victimisation. Just as a reminder, ‘**violence with injury**’ refers to violent

incidents that resulted in physical harm to the victim while ‘**violence without injury**’ refers to violent incidents where no physical harm occurred (see the section on ‘Methodology’ above for further details).

Figure 4. Proportion of violent and non-violent crime, youth and adults



The over- or under-representation of young individuals in specific types of crime relative to the adult population can be assessed using odds ratios, presented in Table 1. Odds ratios compare the likelihood that youths appear as suspects for a given crime type relative to adults. Values above 1 indicate crimes that youth suspects are more likely to commit, while values below 1 indicate crimes that youth suspects are less likely to commit compared to adults.

Table 1. Over and under-representation of youth suspects by crime type

		CRIME	OR
CRIME	OR	Criminal damage	0.96
		Drug trafficking - Class B, C, other	0.81
		Public order	0.75
		Harassment	0.75
		Threats	0.55
		Burglary	0.53
		Theft	0.47
		Other	0.46
		Drug possession - Class A	0.41
		Fraud	0.36
		Violence other	0.06
		Sexual offences	2.81
		Robbery	2.05
		Violence without injury	1.39
		Drug possession - Class B, C, other	1.36
		Violence with injury	1.35
		Weapons	1.21
		Arson	1.15
		Drug trafficking - Class A	1.05

Young individuals exhibit substantially higher odds of involvement as suspects in sexual offences (OR = 2.81) and robbery (OR = 2.05) than adults. More specifically, an odds ratio of 2.81 indicates that youths are nearly three times (2.81 times) as likely as adults to be involved in sexual offences. Young individuals are over-represented in drug possession offences involving Class B and C substances, but not Class A substances; however, they are slightly over-represented in Class A drug trafficking. They are also over-represented in violent offences, including both violence with injury and violence without injury, as well as in weapons

and arson offences. Conversely, youth exhibit lower odds of involvement in offences such as fraud, theft, burglary, and threats, with odds ratios of 0.5 or below relative to adults.

To fully understand violence dynamics within the youth population in Cambridgeshire, we now consider the two sets of youth suspects and youth victims separately, before offering a joint analysis at the end of the section.

3.1 Youth suspects

In line with the literature (see, e.g., Junger-Tas et al. 2004), the majority of individuals aged 18 or below suspected of a crime in Cambridgeshire (N=6,000) are male (68%), while slightly more than one quarter are female – this proportion is similar for both violent and non-violent suspects (Table 2). The much smaller population of individuals suspected of committing violence while in possession of a knife ('knife violence') is even more predominantly male (88.5%), with roughly one in ten being female. Within the set of youths suspected of committing violence with a knife, young Black individuals are over-represented compared to the overall youth suspect population. It is worth noting that ethnicity is self-defined and has been relabelled in accordance with the UK government's classification (GOV.UK 2025a). It should also be noted that results for ethnicity should be interpreted with significant caution, given the high level of missing data for this variable.

Young individuals committing violence with a knife are also disproportionately involved in drug-related criminal activity (43.9%), i.e., 2.6 times more likely than the general youth suspect population, and 2.8 times more likely than violent youth suspects in general. Drug-related crime includes both drug possession and drug trafficking. Additionally, individuals committing violence with a knife are also more likely to be a member of an organised crime group (OCG) than youth suspects in general as well as violent youths, 8.2 times and 4.1 times more likely, respectively. Organised crime group indicates membership of a (predominantly) adult criminal organisation and not a youth gang, hence the relatively small percentage of youths associated with OCGs overall. The variable indicates whether an individual is associated with an OCG based on the police's assessment and intelligence, not only at the time of the offence.

Table 2. Demographic and offence characteristics of youth suspects

Variables	Category	All	Not violent	Violent	Violent with knife
		N 6000	4539	1461	139
Gender	Male	68.1%	67.9%	68.6%	88.5%
	Female	27%	26.8%	27.5%	9.4%
	Unknown	4.9%	5.2%	3.9%	2.2%
Ethnicity	White	86.1%	86.2%	86%	74.5%
	Black	6.1%	6%	6.5%	14.3%
	Asian	4.3%	4.6%	3.5%	5.1%
	Mixed	2.1%	2%	2.5%	3.1%
	Other	1.4%	1.3%	1.6%	3.1%
Knife carrying	Yes	8%	5.3%	16.6%	100%
OCG membership	Yes	0.7%	0.6%	1.4%	5.8%
Drug-related crimes	Yes	16.8%	17.2%	15.7%	43.9%
Theft/Burglary-related crimes	Yes	16.6%	16.7%	16.2%	28.1%
Robbery-related crimes	Yes	5%	3.6%	9.7%	26.6%

3.1.1 *Relational landscape*

Youth suspects may have acted alone (“solo suspects”), or they may have committed the crime for which they are suspected with other individuals (youths or adults). Based on police records, we built a network of suspected co-participation in criminal events (commonly referred to in the literature as ‘co-offending’, although we should reiterate that we are considering a population of suspects, not convicted offenders). Of the 6,000 individuals aged 18 or below under consideration, 42.2% are suspected to have committed at least one crime with at least another individual (of any age; labelled as “In network” in Table 4), while 57.8% are suspected to have only committed solo offences based on police records (labelled as “Not in network” in Table 3).

Table 3. Co-suspects and solo suspects among youth

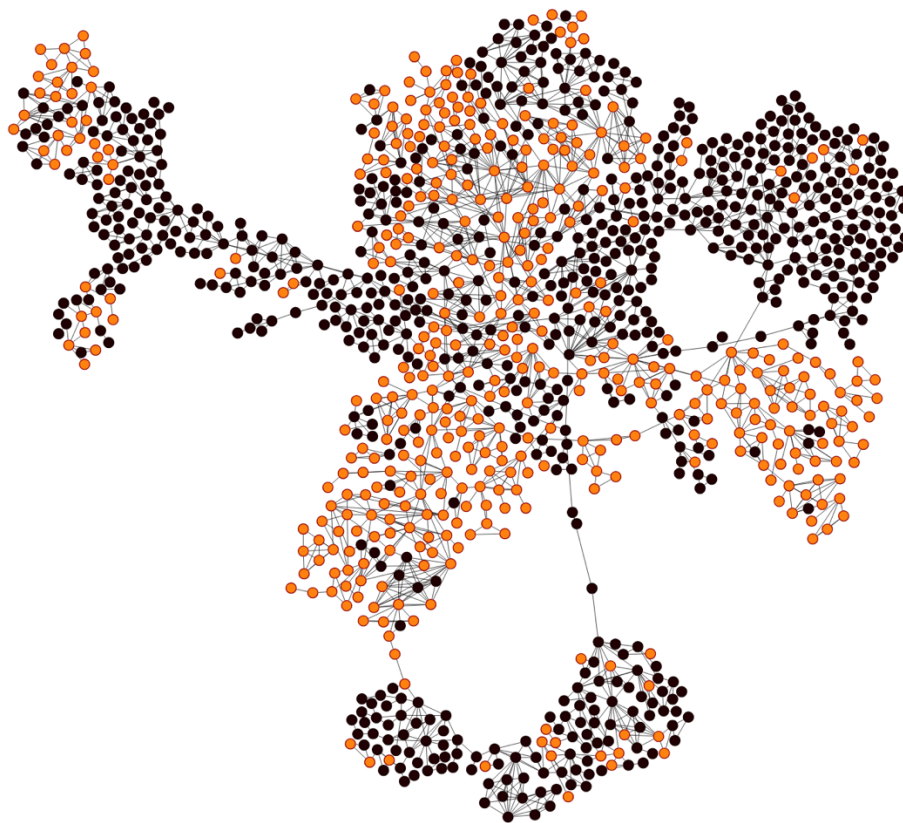
Variables	Category	All	In network	Not in network
		N 6000	2533	3467
Gender	Male	68.1%	70.3%	66.5%
	Female	27%	25.4%	28.1%
	Unknown	4.9%	4.3%	5.4%
Ethnicity	White	86.1%	83%	88.7%
	Black	6.1%	7.6%	4.8%
	Asian	4.3%	4.5%	4.2%
	Mixed	2.1%	3.2%	1.2%
	Other	1.4%	1.6%	1.2%
Knife carrying	Yes	8%	12.3%	5%
OCG membership	Yes	0.7%	1.5%	0.2%
Drug-related crimes	Yes	16.8%	18.8%	15.4%
Theft/Burglary-related crimes	Yes	16.6%	27.2%	8.8%
Robbery-related crimes	Yes	5%	10.3%	1.2%

While the socio-demographic characteristics (gender and ethnicity) remain roughly the same between those who are in the co-suspect network and those who aren't (with a slightly higher proportion of females among the solo suspects and a slightly higher proportion of Black individuals among the networked suspects), we see a distinct difference in crime-related behaviours among the two sets. More specifically, networked individuals are 8.6 times more likely to be suspected of having committed a robbery, 3.1 times more likely to be suspected of having committed a theft or burglary, and 1.23 times more likely to be suspected of being involved in drug-related offences. Importantly, they are also 2.46 times more likely to be suspects in crime events flagged with a knife and, although on a much smaller basis, 7.5 times more likely to have been identified as part of an organised crime group. These descriptive results suggest that it is analytically relevant to distinguish between networked and non-networked individuals, given the substantially different risk and offence profiles observed.

The co-suspect network, comprising youth suspects and their co-suspects of all ages, includes 9,043 individuals (2,533 youth and 6,510 adults; also referred to as 'nodes') and 9,677 suspected co-offending edges (ties). On average, individuals are suspected to have co-offended with 2.14 other individuals (i.e., the average degree). Only a relatively small portion of the network belongs to the fully connected subgroup that contains the largest number of nodes, i.e., what is commonly referred to in network science as the giant component. The largest (giant) component in our co-suspect network comprises 13% of all nodes, corresponding to

1,177 individuals. Figure 5 presents a visual representation of the network largest component.² In this figure, as in all network figures presented in this study, dots represent individuals and lines represent connections. In co-suspect networks, a connection captures suspected co-participation in the same crime event.

Figure 5. Co-suspect network (largest component, youth in orange)



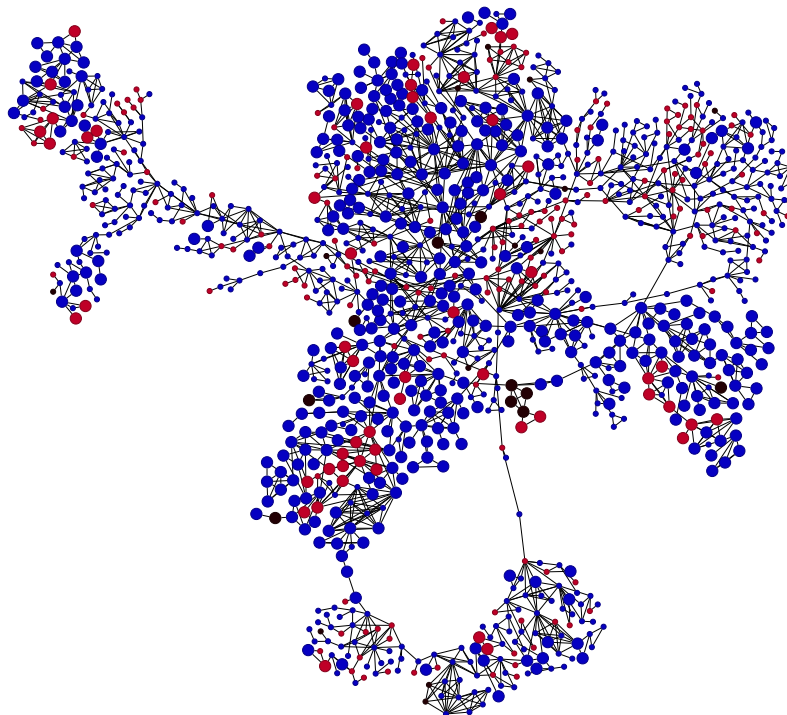
In the largest component of the network, young individuals tend to cluster together. There are, however, exceptions on the top right-hand side, top left-hand side, and bottom, where young individuals are embedded in networks predominantly composed of adult suspects. This suggests that youth embedded in adult-dominated sub-networks may face heightened risk environments. Adult suspected co-offenders typically possess more developed criminal expertise and access to opportunities for serious offending, which may trigger social learning processes whereby young people acquire criminal techniques, justifications, and behavioural patterns from more experienced suspects (consistent with the idea of differential association put forward by Sutherland, 1947; see also Akers, 1998). Exposure to these adult suspects can reinforce offending behaviour through approval and status rewards. Additionally, age disparities create power dynamics that may leave youth vulnerable to manipulation, coercion,

² In all network representations, nodes are displayed using the Force Atlas2, Yifan Hu, and Noverlap algorithms (see Hu 2005; Jacomy et al. 2014).

or exploitation by adult suspects (see, e.g., Warr, 2002). but may also shape longer-term criminal trajectories, including increased offending frequency, escalation to more serious crimes, and diminished prospects for desistance. Although the available data do not permit further testing of this hypothesis, these patterns warrant further investigation and suggest a potentially valuable focus for future research and targeted prevention efforts. Two promising future developments might seek to further explore (a) the interplay between age gaps in youth-adult co-offending relationships and future offending behaviour, including violent behaviour, and (b) the introduction of harm measures, e.g. based on a harm index, to further characterise suspects, in addition to their age.

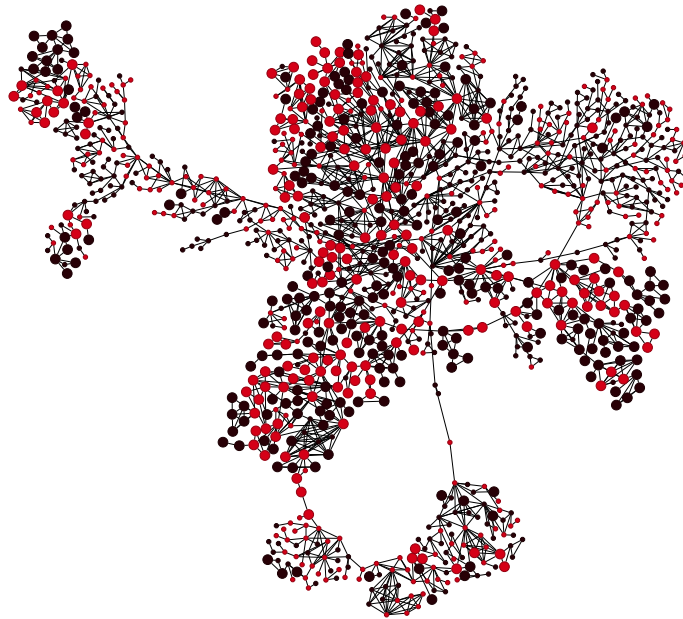
A joint analysis of gender and network position does not reveal strong evidence of clustering, with female suspects dispersed throughout the network (Figure 6). Moving to violence and knife, Figure 7 shows the structural positions of young (and adult) suspects involved in violence with injury events within the broader co-suspect network; Figure 8 of those who have been identified by the police carrying or using a knife at least once; Figure 9 of those committing violence with injury with the use of a knife. In all three cases, there is no strong evidence of clustering, with suspects possessing each of these characteristics dispersed throughout the network. In other words, individuals do not cluster in the co-suspect network based on their violent or knife-related behaviour. Rather than being a defining characteristic that organises suspected co-offending relationships, violence and knife carrying/use appear to result from various social and offending processes operating at different positions within the network.

Figure 6. Co-suspect network, gender



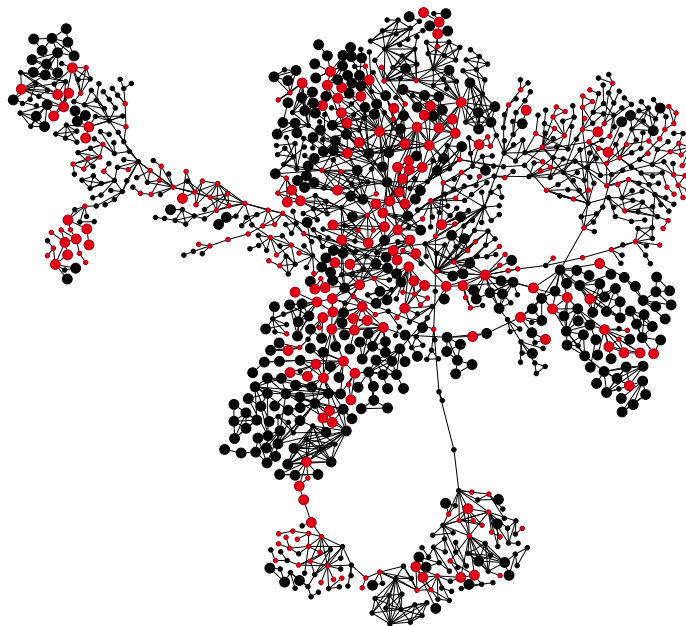
Notes: Largest component only. Larger nodes are the young suspects. Blue nodes are males and red females; dark grey are unknown.

Figure 7. Co-suspect network, violence with injury



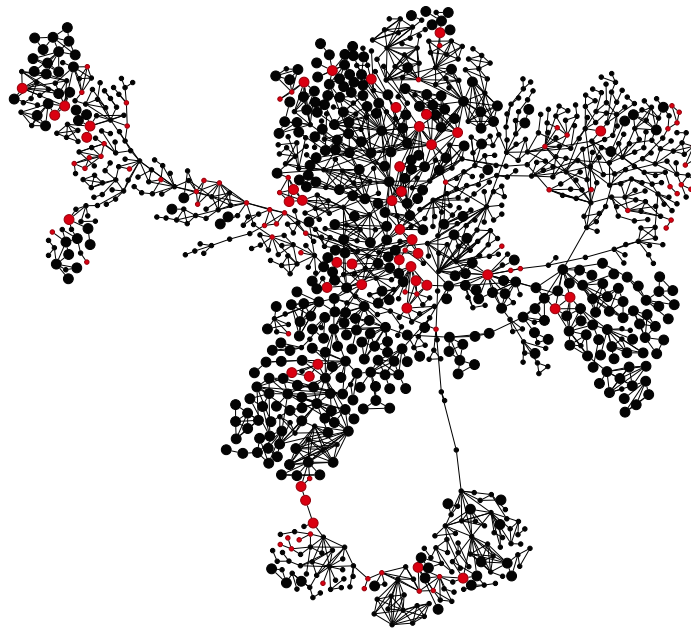
Note: Largest component only. Larger nodes are young suspects. Red nodes have at least once being recorded as suspects in a violence with injury crime.

Figure 8. Co-suspect network, knife carriers



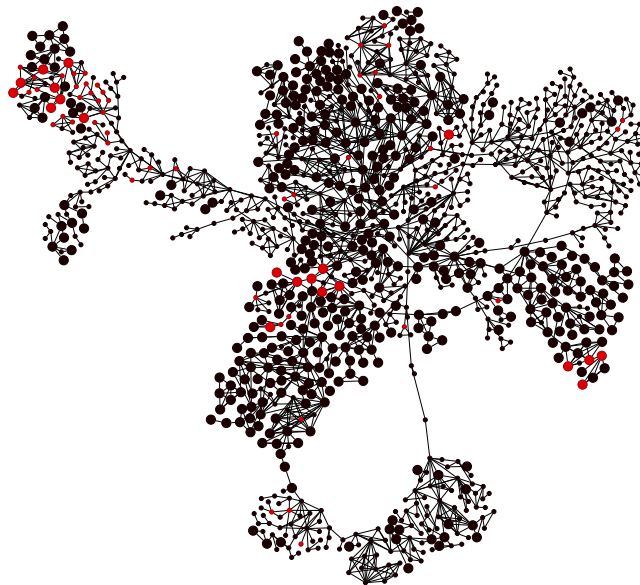
Note: Largest component only. Larger nodes are young suspects. Red nodes have at least once been identified carrying or using a knife.

Figure 9. Co-suspect network, violence with knife



Notes: Largest component only. Larger nodes are young suspects. Red nodes have at least once being recorded as suspects in a violence with injury crime involving a knife.

Figure 10. Co-suspect network, organised crime membership (OCGs)



Notes: Largest component only. Larger nodes are young suspects. Red nodes belong to Organized Crime Groups

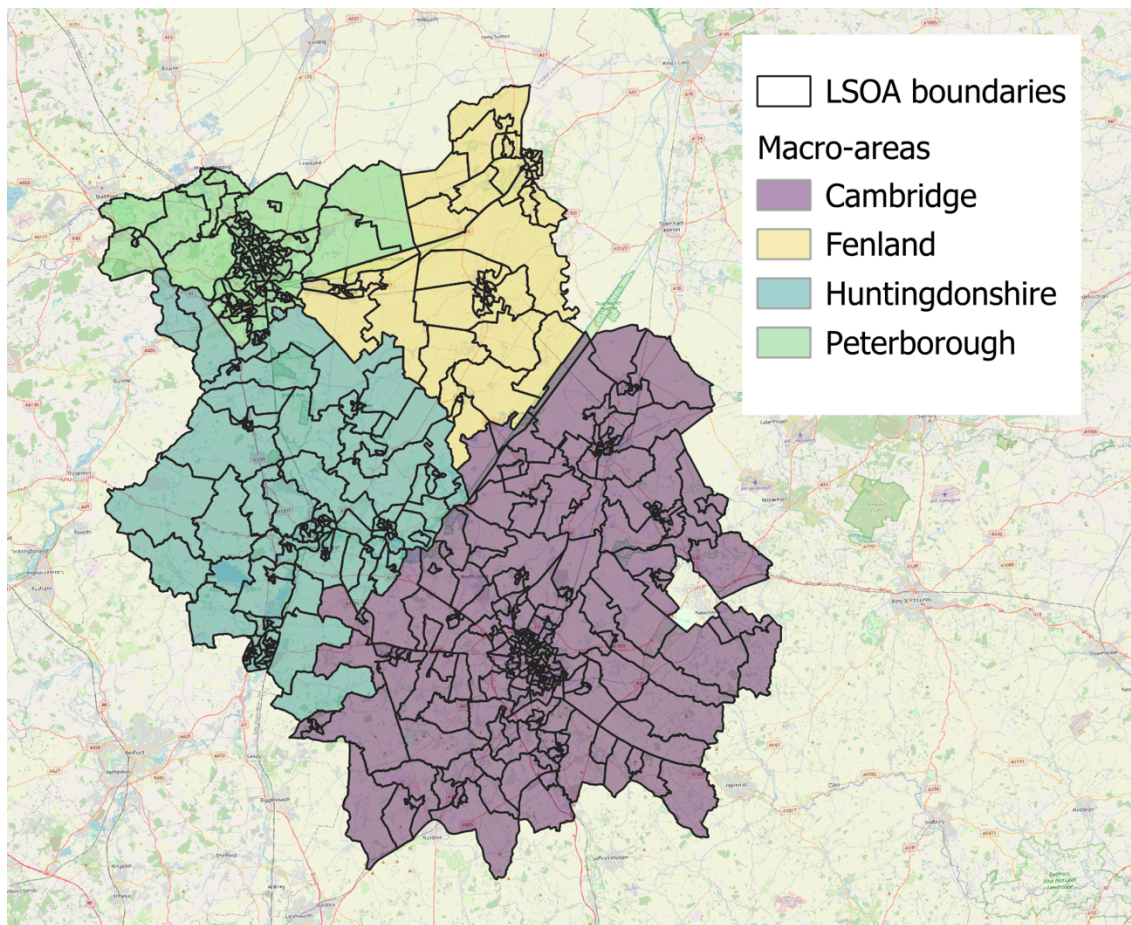
Organised crime members have a slightly higher tendency to clusterization (Figure 10); nonetheless, they are present in different parts of the network. A more pronounced tendency to clusterization is expected, as organised crime groups are, by definition, involved in criminal

activities that require a higher degree of coordination (Campana, Varese and Meneghini 2025; Campana and Varese 2022).

3.1.2 Youth, suspected co-offending and places

We now place the network analysis of suspected co-offending within macro-level geospatial units. We have built four main macro-places within the jurisdiction of Cambridgeshire police: Peterborough, Cambridge, Huntingdonshire and Fenland (Figure 11).

Figure 11. Macro-places within Cambridgeshire



Note: The map shows the classification of Cambridgeshire LSOAs (Lower layer Super Output Areas - a geographical statistical unit designed to contain between 1,000 and 3,000 residents) into macro-places

The distribution of crime events varies markedly across the main areas (Table 4). Cambridge and Peterborough account for the majority of all recorded crime events (39.7% and 34.5%, respectively), while Huntingdonshire (14.9%) and Fenland (10.9%) contribute smaller shares. A similar spatial pattern is observed for violent crime and knife-related violence. Peterborough records the largest share of violent incidents (39.2%), followed closely by Cambridge (36.3%). Taken together, these two areas account for roughly three in four incidents. Within each area,

violent offences account for between 14% and 23% of all crimes, while violent offences involving knives represent a much smaller proportion, ranging from 1.3% to 2.5%.

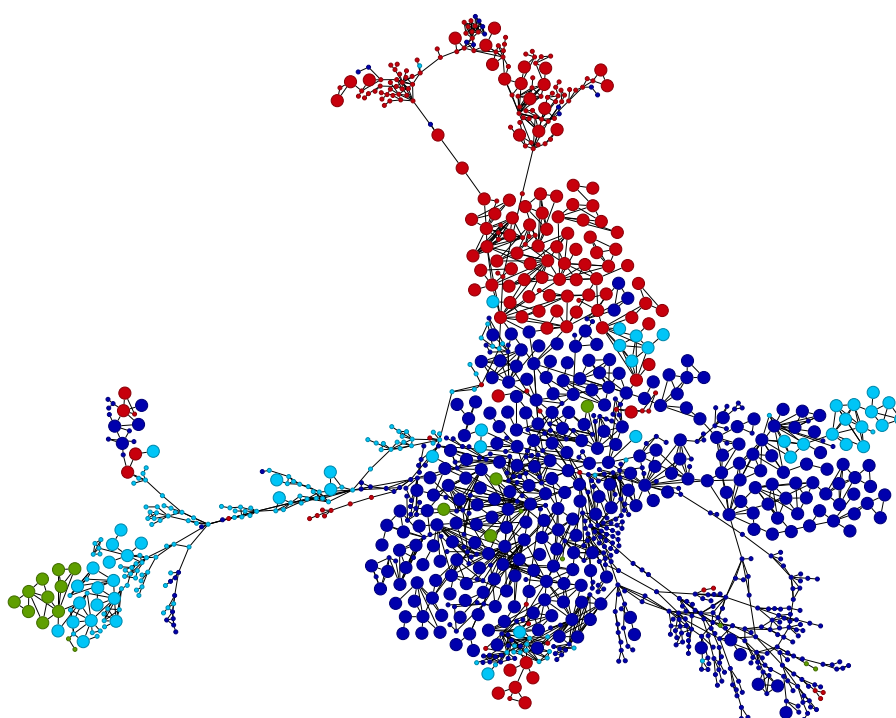
Table 4. Distribution of crime events by macro-places

Main area	Total crime events	% Crime events	Total violent crime events	% Violent crimes within area	% Of violent crimes among areas	Total violence with knife crime events	% Violence with knife crimes within area	% Violence with knife crimes among areas
Cambridge	78843	39.70%	11411	14.47%	36.34%	1580	2.00%	37.53%
Peterborough	68499	34.49%	12323	17.99%	39.24%	1745	2.55%	41.45%
Huntingdonshire	29604	14.90%	4514	15.25%	14.37%	593	2.00%	14.09%
Fenland	21616	10.88%	3140	14.53%	10.00%	292	1.35%	6.94%
Other	59	0.03%	14	23.73%	0.04%	0	0.00%	0.00%

Notes: Other is a residual category capturing crime events recorded by Cambridgeshire Constabulary but occurring outside the county boundaries.

For each youth suspect involved in violent offending, we computed the number of distinct locations in which they committed at least one violent offence. Individuals were then classified according to whether their suspected violent activity was confined to one, two, three, or four or more locations. The vast majority of youth suspects (91.7%) committed violent offences in a single main area, while 6.8% offended in two areas, 1.4% in three areas, and just 0.1% in four or more. When the analysis is restricted to knife-related violence, offending is somewhat more geographically dispersed but remains largely localised: 83.7% of youths are suspected to have committed knife-related violence in one area, 14.1% in two areas, 1.5% in three areas, and 0.7% in four or more. Taken together, these findings indicate that youth violence is predominantly local rather than spatially mobile. This suggests that prevention and enforcement efforts are likely to be most effective when designed and delivered at the level of individual local authorities or policing areas, while cross-area coordination may be most relevant for the relatively small subset of youth whose offending spans multiple areas.

Figure 12. Co-suspect network and macro-places



Note: Largest component only. Larger nodes are young suspects. Node colour indicates the main offending area, i.e. the area where the suspect most frequently has offended in the considered period. Blue is Peterborough (40.3%), Red is Cambridge (32.8%), Green is Fenland (11.5%), Light Blue is Huntingdonshire (15.3%) and Dark Grey is Other (0.01%).

From a relational perspective, the largest component within the co-suspect network displays clear area-specific clustering (Figure 12).³ Individuals from Peterborough predominantly co-offend with others from the same area, and similar patterns of internal clustering are evident for Cambridge and Fenland. Cross-area ties are relatively limited, with only a small number of youth from Fenland embedded within the Peterborough cluster. In contrast, individuals from Huntingdonshire are more diffusely positioned within the network, appearing in smaller groups that collaborate with suspects from multiple other areas rather than forming a single, cohesive cluster of their own. This structure suggests that most suspected co-offending relationships—and the associated risks of violence—are organised within local areas, while a smaller subset of individuals may act as bridges across areas, potentially requiring coordination across local administrative and policing boundaries.

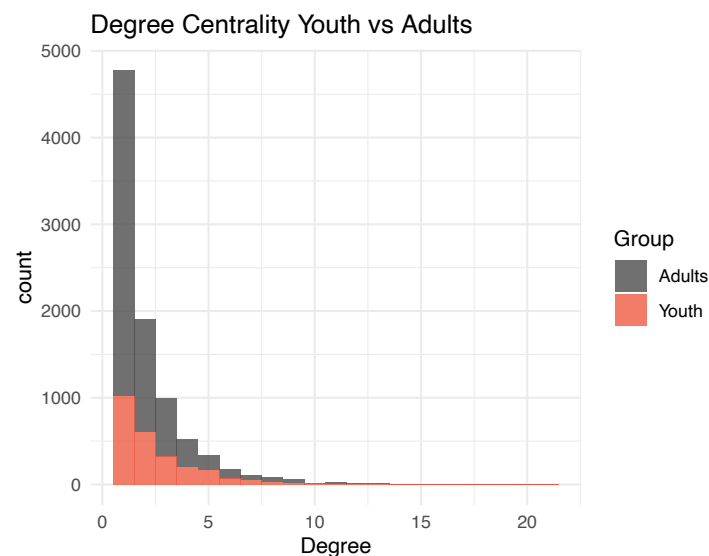
³ For each suspect, offences may occur across multiple geographic areas. The offending area assigned to a suspect corresponds to the location in which they committed offences with the highest frequency over the observation period (i.e. the statistical mode). Suspects for whom no unique modal area could be identified due to ties between areas were excluded from the analysis (approximately 1% of individuals).

3.1.3 Structural positions of youth suspects

We now move to further explore the structural characteristics and positions of youth suspects within the co-suspect network. Firstly, we look at the level of connectedness of young individuals as measured through the degree centrality. Degree centrality is a common measure of activity within a network based on the number of connections (ties) that each individual (node) has (Wasserman and Faust 1994). Put simply, the more connections a person has, the higher their degree centrality; for example, a degree centrality of 2 means the individual has been suspected of co-offending with 2 different people (in one or more crime events).

On average, youth suspects have established a suspected co-offending connection with 2.57⁴ individuals of all ages (i.e., average degree); if we restrict the analysis to connections established with other youths only, the average degree decreases to 2.03. As it is common in social networks, the degree distribution is highly skewed, with a very large number of individuals having a small number of connections and a very long tail (indicating that only a minor proportion of suspects have a very high number of suspected co-offending connections). The degree distribution of young suspects is similar to the degree distribution of adult individuals (Figure 13).

Figure 13. Degree centrality distribution, youth and adults



Note: degree centrality for youth is calculated based on suspected co-offending with individuals of all ages

⁴ This average corresponds to the youth's degree distribution shown in Figure 7 and is computed on the full co-suspect network, including ties to individuals of all ages.

How do young people suspected of violence differ from those suspected of non-violent offences? The distribution of the degree for youths suspected of violence has a longer tail with a higher proportion of individuals with relatively higher degree values, thus suggesting that they tend to be more connected than youths suspected of non-violent crime (Figure 14). This is confirmed by the analysis presented in Table 5, showing that, on average, youths involved in violent incidents exhibit a higher degree centrality than youths involved in non-violent incidents (3.18 versus 2.26). Youths suspected of violence also have a higher maximum degree (21 versus 11), and greater dispersion ($SD = 2.76$ versus 1.62) compared to youths suspected of non-violent crime. Such differences are statistically significant: both Welch's t-test and the Wilcoxon rank-sum test reject the null hypothesis of no difference between the two groups.

Figure 14. Degree centrality distribution, youth suspected of violence and youth suspected of non-violent crime

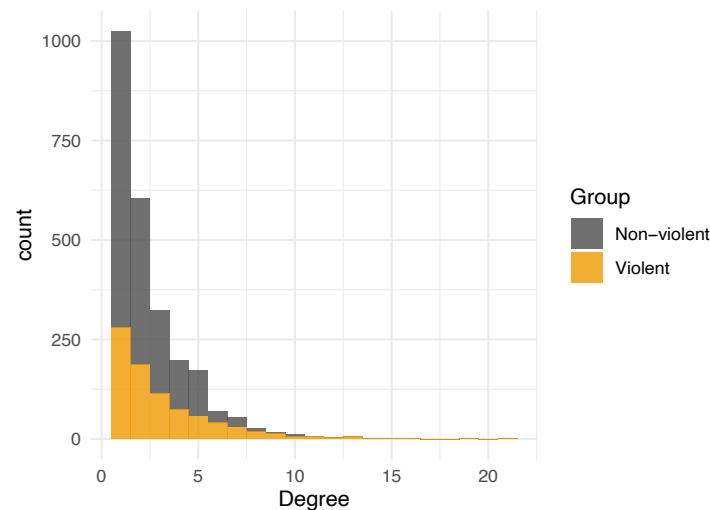
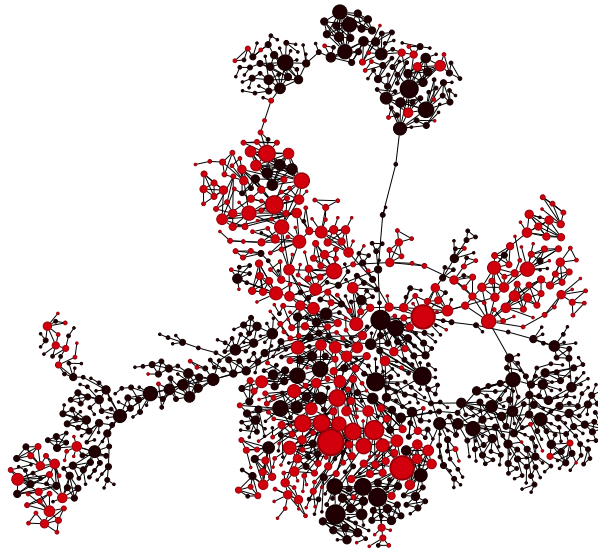


Table 5. Degree centrality: youth suspected of violence and youth suspected of non-violent crime

	Min	Median	Mean	Max	Sd
Youth suspected of violence	1	2	3.18	21	2.76
Youth suspected of non-violent crime	1	2	2.26	11	1.62

Next, we focus on those individuals who are highly connected in the network as measured through degree centrality (i.e. the number of distinct suspected co-offenders). Higher degree individuals, both youth and adults, are scattered around the network – once again not showing any tendency to clusterization (Figure 15).

Figure 15. Co-suspect network, degree distribution



Notes: Largest component only. Red nodes are young suspects. Node size is proportional to the node degree, i.e., the number of suspected co-offenders that each node has.

Previous research on (adult) organised crime milieus in the United Kingdom (Niezink and Campana 2023) has shown that prior co-offending is a key risk factor for violent behaviour. In particular, Niezink and Campana (2023) demonstrate that co-offending relationships can deteriorate over time, giving rise to subsequent victimisation between former co-offenders. Higher levels of co-offending therefore increase opportunities for conflict and exposure to risky social environments. Building on this insight, we further examine the characteristics and involvement in violence and knife carrying of individuals in the top 5% of the overall degree-centrality distribution ($N = 510$, distribution calculated across both youth and adults).

There are 208 young individuals in the top 5% of the degree centrality distribution. Table 6 outlines the characteristics of this highly connected group and compares them to adult “super-connected” individuals in the co-offending network as well as to youth suspects overall.

High-degree youth are predominantly male, and this gender imbalance is considerably stronger than in the youth population overall (87.5% versus 68%). They are disproportionately involved in serious offending. Nearly 65% have committed a violent offence, compared to 24% in the youth suspects population overall; 37.5% have been identified as carrying a knife, versus 8% among all youth; and 42.8% have committed drug-related offences, compared to 17% in the broader youth suspects population. Relative to other youth suspects, high-degree individuals are therefore much more likely to be male, to be affiliated with organised crime groups, and to be involved in violent, knife-related, and drug offences, as well as theft, burglary, and robbery. Ethnic minority youth are also slightly overrepresented. When compared to the top 5% of the adult population, “super-connected” youth share similar demographic characteristics; however, they are more likely to be carrying a knife and considerably more likely to commit robberies and be involved in violence.

Table 6. Highly connected individuals, degree centrality

Variable	Category	All youth	Top 5% degree all	Top 5% degree adults	Top 5% degree youth
		N 6000	510	302	208
Gender	Male	68.07%	87.06%	86.75%	87.50%
	Female	26.98%	10.59%	11.92%	8.65%
	Unknown	4.95%	2.35%	1.32%	3.85%
Ethnicity	White	86.11%	72.81%	71.18%	74.67%
	Black	6.09%	12.81%	13.53%	12.00%
	Asian	4.34%	7.81%	9.41%	6.00%
	Mixed	2.10%	3.75%	3.53%	4.00%
	Other	1.36%	2.81%	2.35%	3.33%
Knife carrying	Yes	8.02%	30.00%	24.83%	37.50%
OCG membership	Yes	0.75%	7.65%	8.28%	6.73%
Drug-related crimes	Yes	16.83%	39.80%	37.75%	42.79%
Theft/burglary-related crimes	Yes	16.57%	41.57%	37.75%	47.12%
Robbery-related crimes	Yes	5.05%	24.31%	17.22%	34.62%
Violence	Yes	24.35%	46.86%	34.44%	64.90%

These findings have clear policy implications. They point to the importance of identifying and potentially prioritising high-degree youth for interventions – as they represent a high-risk population within the broader set of already at-risk population of suspects. It should be noted that high-degree youth are not only at heightened risk of committing violence, but also commit a high volume of offences overall. A degree of 21 (the maximum observed) indicates that the individual has committed at least 21 offences with co-offenders over a period of less than four years, potentially more when solo offences are included. An analysis based on betweenness centrality, an alternative measure of centrality that assesses how often a given individual acts as a bridge between two others in the network, yields similar results (presented in the Appendix).

Taken together, the analyses of degree and betweenness centrality show that structural position within a network matters. More specifically, higher levels of connectivity—captured both by the number of suspected co-offenders and by an individual’s bridging position—are associated with elevated risks of violence and knife carrying. These findings have important implications for prevention and intervention, suggesting that network-informed approaches may help identify individuals and relationships at heightened risk and support more targeted responses.

3.1.4 Assessing the impact of connections on violence and knife-related violence

To further explore the impact of connections on violent behaviour, including knife-related violence, among young suspects, we first focus on the characteristics of individual(s) to which a youth is directly connected through suspected co-offending.

First, we explore descriptively the characteristics of the set of direct connections as a first insight into an individual's personal network. We constructed binary indicators for each individual that capture whether at least one of their direct connections possessed a given characteristic (e.g. male, involved in robbery, OCG member). For each characteristic, the corresponding variable takes the value 1 if a given individual is directly connected to at least one individual with that attribute, and 0 otherwise. We then calculated, for each group (all youth, non-violent youth, youth suspected of violence, and youth suspected of violence with knife), the proportion of individuals who have at least one direct connection with the specified characteristic. Percentages reported in Table 7 indicate the share of individuals who are directly connected to individuals with each attribute.

Table 7. Characteristics of direct connections by type of youth suspect

Variable	Category	All	Not violent	Violent	Violent with knife
Gender	Male	78.09%	78.40%	77.40%	93.90%
	Female	33.87%	32.30%	37.00%	40.40%
Ethnicity	White	62.50%	57.50%	72.50%	80.80%
	Black	10.19%	8.20%	14.00%	36.40%
	Asian	5.29%	5.00%	5.80%	17.20%
	Mixed	3.87%	3.10%	5.30%	9.10%
Knife carrying	Yes	24.91%	19.90%	34.80%	91.90%
OCG membership	Yes	4.66%	4.00%	6.00%	12.10%
Violence	Yes	49.78%	30.10%	88.90%	94.90%
Drug-related crimes	Yes	31.15%	28.70%	36.00%	66.70%
Theft/burglary-related crimes	Yes	42.99%	42.10%	44.70%	66.70%
Robbery-related crimes	Yes	20.92%	16.50%	29.80%	59.60%
Violence & knife	Yes	9.91%	5.40%	18.90%	83.80%

Note: Percentages indicate the share of youth who have at least one connected individual with the specified characteristic. For example, 78.1% of youth in the co-suspect network are connected to at least one male individual, compared to 94% among youth suspected of involvement in knife-related violence.

As the severity of violence rises, so does the proportion of individuals who are directly connected to individuals who are male, are identified as knife carrying, or are suspected to be involved in violent, drug-related, and acquisitive offences (Table 7). This pattern is particularly pronounced among youth suspected of involvement in knife-related violence: 91% are connected to at least one individual identified as knife carrying, compared to 24% in the at-risk

youth population overall, and 67% are connected to individuals suspected of involvement in drug-related offences, compared to 31% overall. Ethnic minority youth are overrepresented among those suspected of knife-related violence.

Proximity scores and regression models

To further examine the relationship between individual and relational risk factors and the likelihood of committing violence with injury or knife-related violence among at-risk youth, i.e., for young individuals who have previously been recorded by the police as suspects in at least one crime incident of any offence type, we move beyond direct suspected co-offending ties and introduce a set of analyses based on network proximity measured through shortest paths. In this work, we introduce a measure that more accurately assesses the impact of connections by capturing both direct and indirect exposure. We term such a measure ‘proximity score’. We calculate such a score based on the concept of shortest path (Wasserman and Faust 1994), which captures the minimum number of steps linking a suspect to someone involved in a specific type of crime, and we apply a transformation so that greater values indicate proximity and lower values distance (with zero indicating no connection).⁵ We present the distributions of proximity scores in Table 8.

Table 8. Descriptive statistics of the distribution of proximity scores, co-suspect network

	Mean	Std	Min	Max
Proximity score OCG member	2.28	8.23	0	12
Proximity score drugs suspect	2.39	5.62	0	6
Proximity score theft/burglary suspect	3.98	4.82	0	8
Proximity score robbery suspect	1.82	6.34	0	6
Proximity score violence with injury suspect	2.75	2.42	0	5
Proximity score knife suspect	2.35	3.17	0	7
Proximity score violence with knife suspect	1.57	2.62	0	7
Proximity score victim of violence	2.26	2.75	0	6

Proximity scores show substantial variation across crime types. On average, individuals are closest—in terms of network distance—to those involved in theft and burglary (mean = 3.98), while they are more distant from individuals linked to robbery (mean = 1.82) and knife-related

⁵ Specifically, for each suspect i , we compute the length of the shortest path x_i connecting them to any suspect involved in the crime type of interest. For ease of interpretation, we normalise this measure using the $\max - x + \min$ transformation, defined as

$$x_i^{\text{norm}} = \max(x) - x_i + \min(x),$$

where $\max(x)$ and $\min(x)$ denote, respectively, the maximum and minimum observed shortest-path lengths for that crime type. This transformation reverses the shortest path scale so that higher values indicate closer proximity, while individuals outside the network are assigned a value of 0.

violence (mean = 1.57). The relatively large standard deviations, particularly for robbery and OCG-related offending, indicate considerable heterogeneity in how individuals are positioned within these crime-specific subnetworks. To assess the impact of proximity on the likelihood of committing violence with injury and knife violence, we introduce such scores into a series of regression models.

To examine how individual and relational characteristics *jointly* shape the likelihood of violence with injury and knife-related violence, we turn to regression models.

In Tables 9 and 10, we explore the factors related to a higher likelihood for the young person to commit violence with injury and knife-related violence with injury, respectively. For both, we ran a Bayesian logistic ridge regression model fitted on three different populations: the whole population of young suspects ($N = 6,000$), those who are part of the co-suspect network, meaning they have been suspected of co-offending with at least one other person at least once (“In network”; $N = 2,533$) and those who have never been suspected of co-offending with another person of any age (“Not in network”; $N = 3,467$).

Results in Table 9 (column “All”) indicate that violent behaviour is more common among individuals affiliated with organised crime groups (OCGs) and among those involved in robbery. In contrast, individuals involved in theft, burglary, or drug-related offences are around 20% less likely to engage in violence than those not involved in these activities, once other characteristics are taken into account.

An important finding is that, when considering the full population of at-risk youth, including individuals outside the co-suspect network, the results show that being embedded in the co-suspect network is associated with roughly 30% higher odds of violent behaviour, indicating that being connected to at least one suspected co-offender already marks an elevated level of risk. No statistically significant differences are observed by ethnicity or gender.

When focusing specifically on individuals who are part of the co-suspect network, the results further highlight the central role of network embeddedness in shaping violent behaviour. Conditional on being in the network, individuals who are more connected are substantially more likely to engage in violence. In the in-network model, each additional co-suspect is associated with an increase in the odds of violent behaviour of around 20% (odds ratio = 1.20). Given that youth suspects in the network have, on average, approximately 2.6 co-suspects, this implies that a typically network-embedded suspect faces substantially higher odds of violent offending (one and a half times more likely) than a minimally connected network member, reinforcing the importance of cumulative network exposure beyond mere participation.

Proximity within the network also matters, but not uniformly across all types of criminal activity. Individuals who are closer to others involved in robberies or are part of an organised crime group exhibit higher odds of violent behaviour. In other words, closer exposure within the network to individuals engaged in robbery or involved in organised crime further amplifies the risk of committing violence.

Crucially, proximity to a suspect who has also been a victim of violence increases the probability of committing violence. This suggests that violent behaviour may spread through social proximity, with youth exposed to violence-involved individuals – peers and adults – facing elevated risk (an increase in odds of 9.4%). Further qualitative work is needed to pinpoint the underlying social mechanisms at play, including differential association and social learning, coercion, reputational pressures that may normalise or incentivise violent behaviour, or — more generally — shared exposure to risky environments. Our data do not allow us to disentangle these mechanisms, and qualitative follow-up work would be particularly valuable in this respect.

Individuals who are not embedded in the co-suspect network show a different pattern, with involvement in specific crime types consistently associated with a lower probability of violent behaviour or non-statistically significant effects. *This indicates that network involvement itself—rather than offence type alone—is a key driver of the risk of committing violence.* These findings suggest the value of incorporating network-based indicators into preventive frameworks to support early interventions aimed at reducing violence.

Table 10. Violence with knife, youth suspects, odds ratios

Parameter	All	Not in network	In network	In network	In network	In network	In network	In network	In network
(Intercept)	0.007	0.011	0.012	0.012	0.010	0.010	0.009	0.009	
Gender: Male	1.800 **	1.093	1.691 **	1.591 *	1.571 *	1.650 *	1.531 *	1.657 *	
Gender: Unknown	0.991	1.009	0.635	0.658	0.644	0.631	0.614	0.648	
Ethnicity: Asian	1.156	0.988	0.948	0.949	0.914	0.993	0.997	0.985	
Ethnicity: Black	1.879 *	1.096	1.563 *	1.523 *	1.495 *	1.538 *	1.473	1.615 *	
Ethnicity: Mixed	1.065	0.831	0.958	0.936	0.991	1.030	0.915	0.976	
Ethnicity: Not stated	1.058	0.985	0.691 *	0.712 *	0.707 *	0.710 *	0.716 *	0.722 *	
OCG	2.128 *	0.748	1.986 *	1.530	1.971 *	1.969 *	1.779 *	1.895 *	
Drugs	2.096 **	1.025	2.563 **	2.319 **	2.125 **	2.482 **	2.378 **	2.410 **	
Theft and Burglary	0.976	0.943	0.969	0.965	0.970	0.844	0.940	0.939	
Robbery	2.670 **	1.444	2.076 **	1.908 **	1.940 **	1.964 **	1.370 *	1.823 **	
Degree (co-suspects direct connections)	1.191 **		1.142 **	1.108 **	1.122 **	1.125 **	1.094 **	1.102 **	
Proximity score OCG member				1.065 **					
Proximity score drugs suspect					1.102 **				
Proximity score theft/burglary susp.						1.068 **			
Proximity score robbery suspect							1.229 **		
Proximity score victim of violence								1.152 **	
N	6000	3467	2533	2533	2533	2533	2533	2533	
WAIC	582.7	215.6	365.97	362.80	363.88	363.74	353.99	359.44	
Number of Is	139	40	99	99	99	99	99	99	

Moving to the subset of individuals involved in knife-related violence (Table 10), we observe a significant effect of gender (being a male) and ethnicity (being of Black ethnicity) on the likelihood of being suspected of committing knife violence.⁶ Contrary to violence with injury overall, knife violence is impacted by involvement in all types of criminal activities, with the strongest effects for robbery and drug-related activity. OCG membership also increases the odds of knife violence.

As with general violence, knife violence patterns differ based on whether individuals are part of co-suspect networks. Those not embedded in networks show no significant effects for individual or offending characteristics. Crucially, networked individuals present several key risk factors.

An important finding is that the number of co-suspects (i.e., ‘degree’ in network terms) is strongly associated with risk of knife violence: being connected with another suspect, *regardless of the type of crime*, increases the odds of knife violence by roughly 12%. Given that the average youth in the network has approximately 2.6 co-suspects, this corresponds to about 35% higher odds relative to a minimally connected member. Secondly, beyond direct connections, proximity to individuals involved in robbery, drugs, or theft/burglary increases the odds of knife violence by 23%, 10% and 7%, respectively. Thirdly, proximity to OCG members is also contributing to elevate risk, though to a lesser extent. In other words, both direct network connections (embeddedness) and indirect exposure through network proximity amplify the risk of knife violence, with the largest effects observed for proximity to robbery-involved co-suspects.

Crucially, social proximity to a suspect who was also a victim of violence increases the likelihood of committing knife violence, suggesting that exposure to violence-involved individuals—whether peers or adults—elevates risk (an increase in odds of knife violence of 15.2%).

In sum, previous studies have focused on individual-level factors, highlighting associations between violence and other crimes (e.g., Farrington 1998; Thornberry et al. 1995). Our study builds on and extends this work in several ways. First, we demonstrate that, among at-risk youth, network embeddedness independently predicts violence risk over and above individual characteristics. More strikingly, among non-networked youth, no individual characteristic significantly predicts violence, suggesting that the network is not merely a correlate of risk but central to how risk operates. In this sense, networked and non-networked at-risk youth almost represent two distinct populations in terms of risk profile.

These findings sit within a well-established body of research highlighting strong associations between affiliation with delinquent or antisocial peers and involvement in violent behaviour (Conway and McCord 2002; Haynie et al. 2006; Lipsey and Derzon 1998; Segeren et al. 2020; Thornberry et al. 1995). At the same time, our full network approach goes beyond this literature

⁶ Results for ethnicity should be read with caution given the high number of missing data.

in important respects. By modelling indirect exposure through shortest-path distances, we offer a richer picture of risk that extends beyond direct connections. We also show that proximity to a suspect who has also been a victim of violence increases the probability of committing violence. Finally, the identification of a structurally distinct group of 'super-connected' youth as a high-risk subgroup has direct implications for enhancing existing risk-scoring tools.

Future research should seek to confirm these findings with a larger set of knife-related incidents. In our data, the knife-related violence models are estimated on a rather small set of events recorded by the police, with knife-involved cases representing only around 2% of observations. This limits statistical power and affects the stability of estimates, particularly for individuals not embedded in the co-suspect network, for whom none of the coefficients reaches statistical significance.

3.2 Youth victims

Having explored the structural features of violent youth offending and the relational determinants of committing violence with injury – with and without the use of a knife – among an at-risk population (namely, youth suspects of any crime), we now turn to the other face of the phenomenon: victimisation. In this section, we explore the structural features and determinants of violent victimisation among young persons in Cambridgeshire. As already mentioned, we have two groups of victims: (a) youth victims who have never been recorded as suspects for any offence in the period covered by the data; (b) youth victims who have also been recorded as suspects for at least one offence of any type during the period under consideration. We term the first group 'victim-only' and the second 'victim-offender'. To further explore the role of knives in victimisation, we further identify youth who have been victims of any type of knife event, including violence, at least once and youth who have been victims of violence with a knife causing injuries (the latter is a subset of the former).

Over the period under consideration, 10,491 young individuals aged 10–18 were recorded as victims of at least one crime. The majority (78%) were recorded solely as victims, while 22% were also identified as suspects in a separate crime event (Table 11). Within the same period, 1,968 young individuals were victims of violence. Among this group, approximately one-third were also recorded as suspects in another offence, indicating a substantially higher prevalence of victim-offender overlap for victims of violence compared with overall victimisation.

The likelihood of victim-offender overlap increases with the seriousness of the crime. Among all youth victims of violence with injury, the proportion of individuals recorded as both suspect and victim is 34.8%; this increases to 41% among knife-related victims and almost 60% among victims of knife-related violence (note that this latter group is relatively small, including only 127 individuals aged 10-18). These findings highlight a strong concentration of serious violence among a relatively small cohort of young people who are also likely to be involved in offending.

Table 11. Youth victimisation, all types

Variable	Category	All	Violence with injury victims	Knife victims	Violence with knife victims
		N 10491	1968	513	127
Type of victim	Victim only	78.1%	65.2%	57.9%	40.2%
	Also suspect	21.9%	34.8%	41.1%	59.8%
Gender	Male	54.1%	67.1%	79.0%	87.4%
	Female	41.5%	28.2%	17.2%	8.7%
	Unknown	4.5%	4.7%	3.9%	3.9%
Ethnicity	White	88.1%	85.9%	84.4%	72.0%
	Black	2.9%	3.4%	5.6%	12.2%
	Asian	5.5%	6.2%	7.0%	11.0%
	Mixed	2.6%	3.1%	1.3%	1.2%
	Other	0.9%	1.4%	1.7%	3.7%
OCG membership	Yes	0.3%	0.6%	2.0%	3.9%

Gender disparities also widen as the seriousness of violence escalates. While males constitute a slight majority of all victims (54.1%), their representation rises sharply in more serious crime categories, reaching 87.4% among victims of knife-enabled violence. White victims remain the largest group across all populations; however, individuals from minority ethnic backgrounds are increasingly more represented in both knife-related categories.

Victims flagged as having links to organised crime groups (OCGs) are rare across the overall youth victim population but are disproportionately represented in higher-harm offences, particularly those involving knives. Specifically, individuals identified as OCG members are 6.5 times more likely to be victims of knife-related violence than of violence with injury overall, and 13 times more likely to be victims of crime of any type.

3.2.1 Relational Landscape

Consistent with the analysis presented in the preceding section, this section examines how victims are positioned within the relational network of violence, and whether victimisation exhibits systematic relational patterns. To do so, we construct and analyse two complementary networks. First, the violent victimisation network, which links youth victims of violence to suspects of any age, allowing us to study who victimises young people and whether victimisation is concentrated or dispersed across different perpetrators. Second, we enrich our relational picture by integrating information on victimisation (i.e., being a victim of violence and being a victim of knife violence) into the co-suspect network already introduced in the previous section. This dual-network approach enables us to assess both the direct pathways through which young people experience violent victimisation and the relationship between the structural context of their involvement in networks of suspected co-offending and violent victimisation.

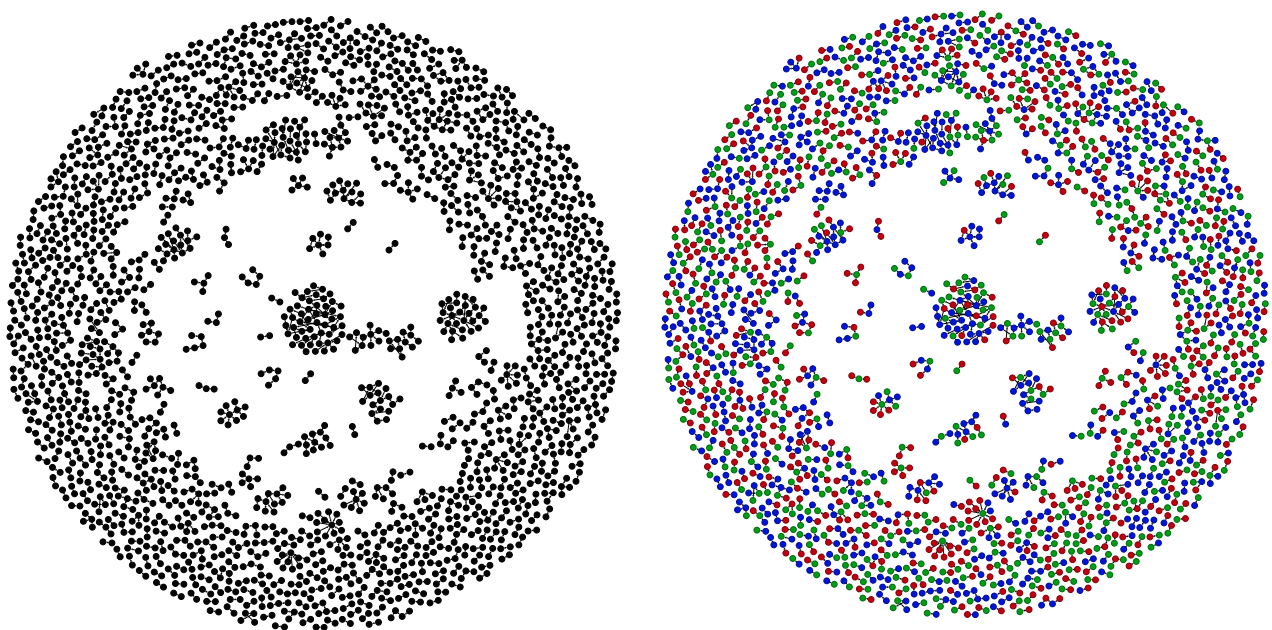
Victimisation network

First, we base our analysis on the violent victimisation network that links youth victims of violence to suspects of any age to understand *who* victimises young people and whether harm is concentrated or spread across different suspects (Figure 16).

The youth violent victimisation network, which, once again, includes all youth victims of violence and suspects of any age, is made of 2,285 individuals in both roles (suspects and victims), who have established 1,502 violent victimisation relations (links), where each relation represents an instance in which a suspect has committed violence against a youth victim. The largest connected component in the network (giant component) includes 51 individuals, corresponding to 2.23% of the entire network. Importantly, all the individuals in the giant component are youth, making it a highly-connected cluster of young individuals involved in violence as either victims or suspects or both. The largest connected component also presents opportunities for intervention. Targeting this core group of 51 individuals has the potential to disrupt a disproportionate share of victimisation pathways.

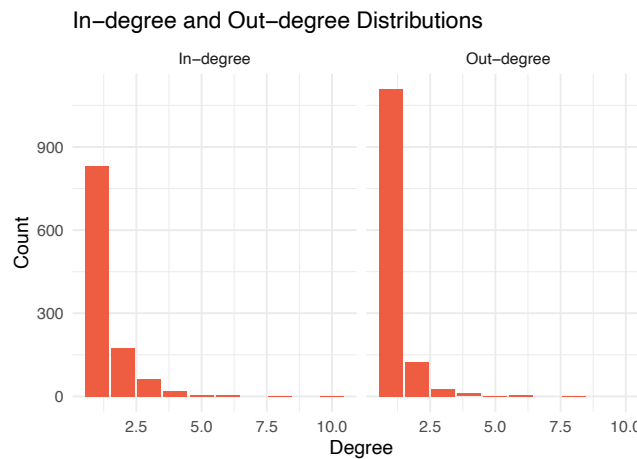
High levels of network connectivity increase the risk that violence propagates through mechanisms such as retaliation, peer influence, and shared social contexts (see, among others, Akers 1998, Papachristos et al. 2013; 2014a and 2014b, Niezink and Campana 2023) As a result, individuals embedded within the giant component are likely to face elevated risks of repeat victimisation and escalation. Figure 16 shows the structure of the entire victimisation network with the largest component plotted at the centre. From the network structure, we can identify additional (smaller) components of potential interest for intervention: the second largest one includes 28 individuals (1.2%), the third largest one 26 (1.1%)

Figure 16. Victimisation network, all roles



Note: In the left-hand side picture, node colour is based on the node roles. Green are victims only, Blue are both victims and suspects, and Red are suspects only.

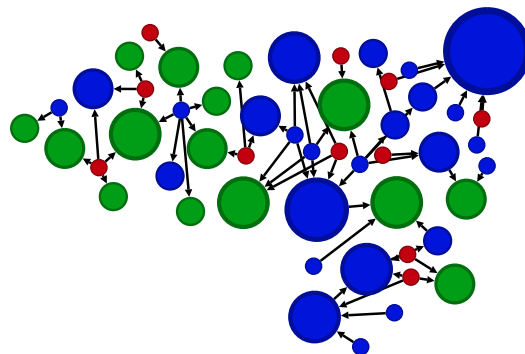
Figure 17. Victimisation network, in-degree and out-degree distribution



Next, we focus on the violent victimisation dyads – i.e., pairs of nodes (individuals) connected by a directed violent victimisation relationship going from node A (suspect) to node B (victim). In this analysis, we consider each unique $A \rightarrow B$ pair only once, regardless of the number of times node A has victimised node B. On average, each suspect has victimised 1.19 victims, while each victim has been victimised on average by 1.38 individuals.

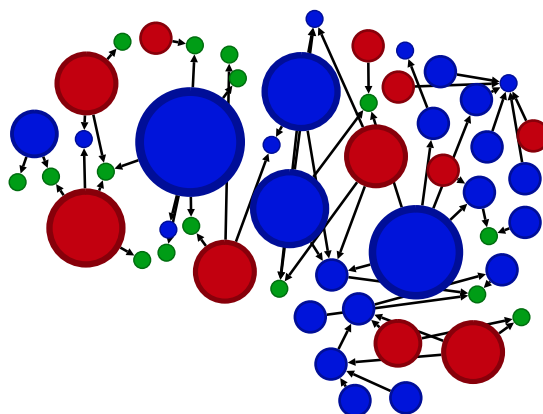
In network terminology, out-degree measures how many different individuals a person has victimised, while in-degree measures how many different offenders have victimised a given individual. The maximum out-degree is 8 (meaning that the maximum number of victims attacked by the same individual is 8), while the maximum in-degree is 10 (meaning that some victims have been victimised by 10 different suspects). Figure 17 presents both degree distributions, which are – as expected – left skewed, with most individuals being involved in a few victimisation events as either suspects or victims. Figures 18 and 19 highlight the position of high-degree individuals, high victimisation (in-degree) and high offending (out-degree), respectively, within the largest component. The network pictures show no discernible tendency toward clusterization.

Figure 18. Victimisation network by role and in-degree centrality, largest component



Note: Node size is proportional to in-degree, i.e., the number of incoming violent ties that each node has. Node colour is based on the node roles. Green are victims only, Blue are both victims and suspects, and Red are suspects only.

Figure 19. Victimisation network by role and out-degree centrality, largest component



Note: Node size is proportional to out-degree, i.e. the number of outgoing edges that each node has. Node colour is based on the node roles. Green are victims only, Blue are both victims and suspects, and Red are suspects only.

Next, we consider three different youth victim populations:

1. Young individuals victimised once during the study period;
2. Young individuals victimised multiple times by the same suspect;
3. Young individuals victimised multiple times by different suspects.

Table 12 compares the descriptive characteristics of the three victim groups. Repeated victimisation is strongly associated with a higher prevalence of individuals who are both victims and suspects. While approximately one-third of individuals victimised once are also recorded as suspects in other crime events, this proportion rises to 40% among those victimised multiple times by the same suspect, and to 43% among those victimised multiple times by different suspects. Although repeat victimisation by the same suspect does occur, it remains rare. When violence is repeated, it typically involves different suspects rather than the same individual — a pattern that contrasts markedly with the dynamics underpinning, e.g., (adult) intimate partner violence.

Table 12. Youth violent victimisation, frequency and pattern

Variable	Category	Single victimisation	Multiple victimisation same suspect	Multiple victimisation different suspects
	N	831	5	265
Type of victim	Victim only	63.7%	60.0%	57.0%
	Also suspect	36.3%	40.0%	43.0%
Gender	Male	64.3%	40.0%	62.3%
	Female	31.3%	40.0%	35.1%
	Unknown	4.5%	20.0%	2.6%
Ethnicity	White	88.6%	50.0%	86.7%
	Black	3.4%	0.0%	4.9%
	Asian	5.0%	25.0%	4.9%
	Mixed	2.5%	25.0%	2.4%
	Other	0.6%	0.0%	1.2%
OCG membership	Yes	0.6%	0.0%	0.4%

Gender composition is broadly stable across groups, with males accounting for around 60% of victims in each category. Ethnic composition is predominantly White across all groups; however, Black individuals are slightly overrepresented among individuals victimised by multiple suspects.⁷ Victims flagged as having links to organised crime groups (OCGs) are very rare (less than 1%) across all groups. Where present, they are more commonly observed among individuals victimised once or by multiple suspects, rather than those repeatedly victimised by the same suspect.

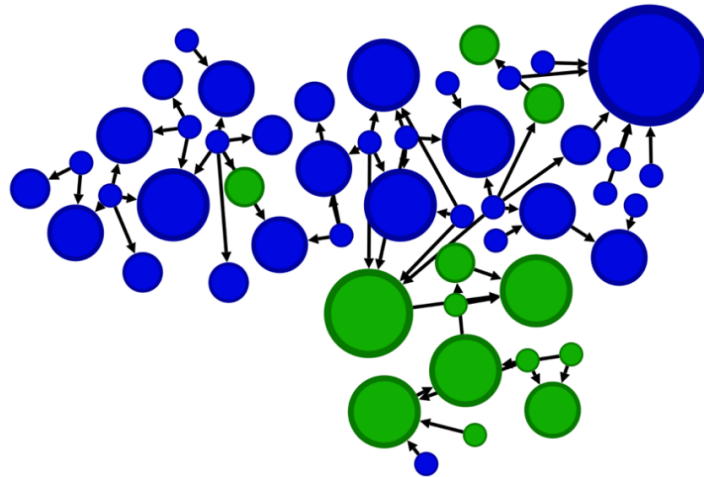
Overall, these findings suggest that repeat victimisation is concentrated among a subgroup of young people with overlapping victim–suspect profiles and slightly greater ethnic diversity, while gender patterns remain largely unchanged.

3.2.2 Structural features of the victimisation network

We now investigate the structural properties of the victimisation network, with particular attention to how individuals with specific characteristics are positioned within the network structure.

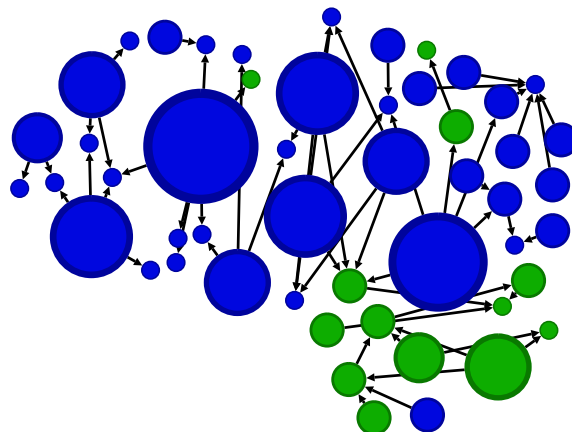
^{7 7} Results for ethnicity should be read with caution given the high number of missing data.

Figure 20. Victimisation network by in-degree and gender, largest component



Note: Node size is proportional to in-degree, i.e. the number of incoming edges that each node has. Node colour is based on the node gender. Blue are male, green are females and black are Unknown.

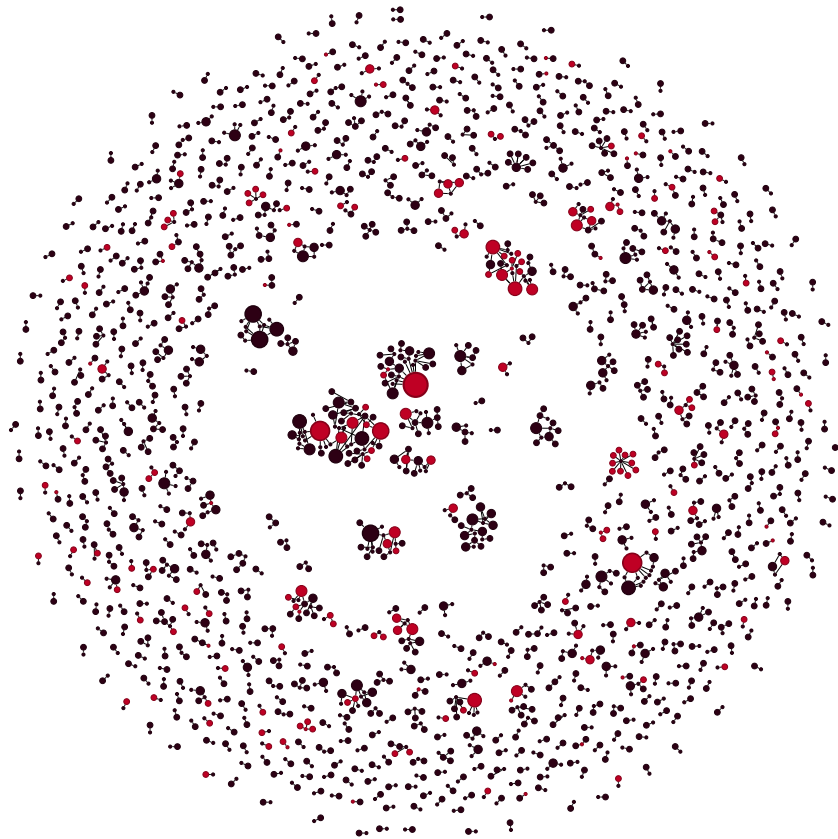
Figure 21. Victimisation network by out-degree and gender, largest component



Node size is proportional to out-degree, i.e. the number of outgoing edges that each node has. Node colour is based on the node gender. Blue are male and green are females.

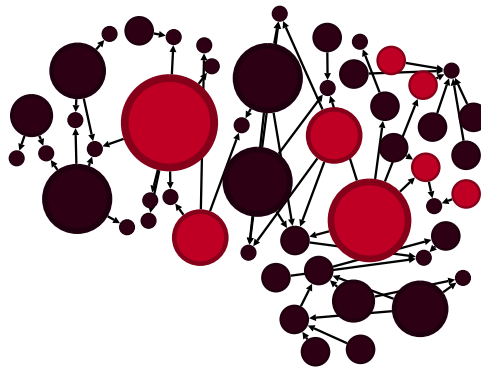
Visual representations of the largest component reveal some tendency toward clusterization based on gender (Figures 20 and 21). In contrast, knife carrying does not appear to be clustered but rather is distributed across the entire network (Figure 22). A similar pattern is observed within the largest component (Figure 23).

Figure 22. Victimisation network by out-degree and knife possession, entire network



Note: Node size is proportional to out-degree, i.e. the number of outgoing victimisation ties that each node has. Red nodes are individuals identified at least once carrying a knife.

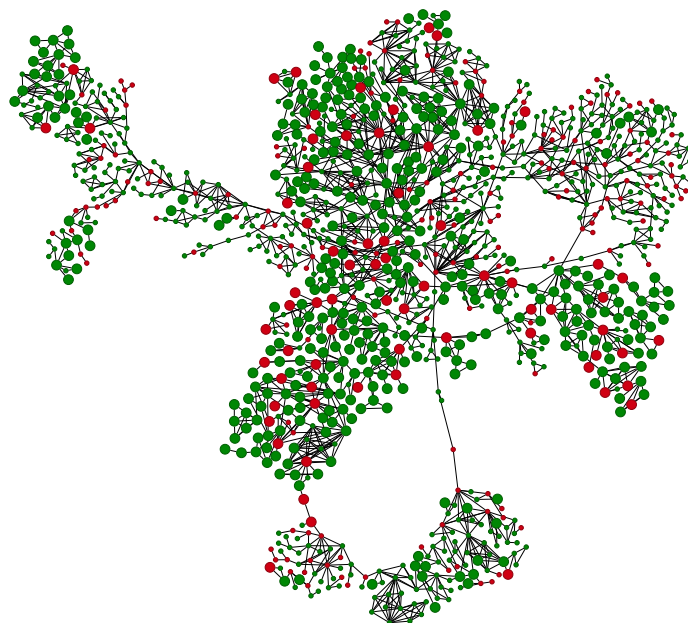
Figure 23. Victimisation network by out-degree and knife possession, largest component



Note: Node size is proportional to out-degree, i.e. number of outgoing victimisation ties that each node has. Red nodes are individuals identified at least once carrying a knife.

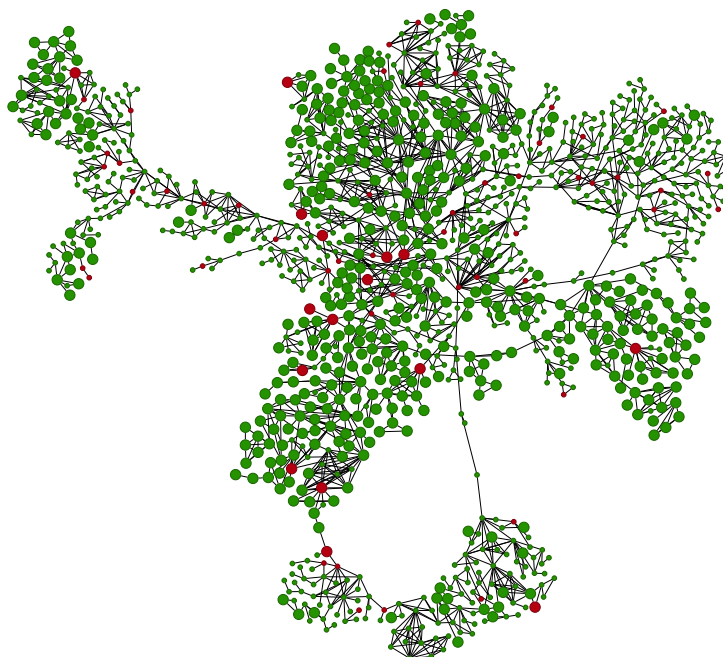
Next, we turn to our second network: the co-suspect network. We explore where victims of violence (Figure 24) and victims of knife violence (Figure 25) are positioned within this network. In both cases, there is no discernible tendency toward clusterisation; rather, these individuals are distributed across the entire network.

Figure 24. Co-offending network and victims of violence, largest component



Note: larger nodes are youth suspects. Red nodes are individuals who have been at least once a victim of violence with injury; green nodes are those who have not.

Figure 25. Co-offending network and victims of knife violence, largest component



Note: larger nodes are youth offenders. Red nodes are individuals who have been at least once a victim of violence with a knife; green nodes are those who have not.

3.2.3 Assessing the impact of connections on violent victimisation

To further explore the impact of connections on violent victimisation, including knife-related violent victimisation, we first focus on the characteristics of individual(s) to which a youth is directly connected through suspected co-offending. Do the characteristics of direct connections differ between victims of violent and non-violent crime? How do these characteristics further differ between victims of violence and victims of knife-related violence?

We take the characteristics of the individuals directly connected to a person through suspected co-offending relationships as a proxy for an individual's direct exposure to high-risk social environments. Our analysis focuses on the characteristics of direct connections for three groups of victims:

1. Victims of violence
2. Victims of knife-related violence
3. Victims of non-violent crime

To ensure the meaningful identification of direct connections, the analysis is restricted to victims who have been recorded as suspects at least once. By definition, individuals who have never been suspected of a crime have no co-suspects and therefore no observable direct exposure to high-risk social environments.

This approach allows us to assess whether exposure to risky social environments differs systematically across victimisation types, and whether increasingly severe forms of violence (from non-violent victimisation to violence and knife-related violence) are associated with progressively higher-risk environments.

Table 13. Characteristics of direct connections by violence type

Variable	Category	Not victims of violence	Victims of violence	Victims of violence with knife
Gender		N	2226	307
	Male		78.40%	97.80%
	Female		32.60%	43.00%
Ethnicity	White	61.00%	73.00%	84.40%
	Black	9.80%	13.00%	28.90%
	Asian	4.90%	7.80%	20.00%
	Mixed	3.80%	4.60%	6.70%
Knife carrying	Yes	23.10%	38.10%	64.40%
OCG membership	Yes	4.20%	8.10%	15.60%
Violence	Yes	47.60%	64.50%	86.70%
Drug-related crimes	Yes	29.70%	41.40%	68.90%
Theft/burglary-related crimes	Yes	41.90%	51.10%	71.10%
Robbery-related crimes	Yes	19.40%	31.90%	60.00%
Violence & knife	Yes	8.80%	17.60%	40.00%

There is a clear pattern of intensification in risk exposure as victimisation severity increases, with individuals placed in progressively higher-risk social environments. Victims of more severe forms of violence are disproportionately connected to individuals exhibiting elevated risk profiles, including higher probabilities of being male, identified as knife-carrying, and suspected of being involved in violence or a criminal activity of any type. For example, the proportion of individuals connected to at least one individual identified as knife-carrying increases from 23.1% among victims of crimes other than violence, to 38.1% among victims of violence, and to 64.4% among victims of knife-related violence. Comparable patterns are observed across other crime-related indicators.

In addition, the ethnic distribution of direct connections varies across victimisation categories, with an increased prevalence of White individuals among victims of violence generally, and a shift toward higher proportions of Black and Asian individuals within the direct connections of knife-related violence victims.

Taken together, these findings suggest that severe victimisation is associated not only with individual-level exposure to violence, but also with structural embeddedness in offending networks characterised by concentrated risk and exposure to violent, knife-related and criminal behaviours.

Proximity scores and regression models

Similar to the earlier analysis of suspects, we extend the assessment of exposure to risky social environments beyond direct connections. This is done using *proximity scores*, which capture both direct and indirect connections within social networks. These scores are based on the idea of “shortest paths” (Wasserman and Faust, 1994), meaning the minimum number of steps needed to link an individual to another individual with a particular characteristic. To help interpretation, shortest paths are converted into a proximity measure: higher values indicate closer social proximity, lower values indicate greater distance, and zero indicates no connection at all. This allows us to assess not only to whom a given person is directly connected to, but also the wider risk environment in which they are socially embedded.

Table 14. Proximity scores, victims embedded in co-suspect networks

	Mean	Std	Min	Max
Proximity score violence victim	2.26	2.75	0	6
Proximity score violence with knife victim	1.73	2.88	0	8

Analysis of proximity scores (normalised shortest paths) shows that, on average, individuals in the co-suspect network are closest to violence victims (mean 2.26) than a victim of violence with knife (mean 1.73). This suggests that the latter is concentrated within more tightly bounded, high-risk social networks .

Table 15. Logistic regression models, violent victimisation (violence with injury)

Parameter	All		Not in network		In network		In network		In network		In network		In network		In network	
(Intercept)	0.141		0.132		0.147		0.145		0.141		0.145		0.143		0.119	
Gender: Male	0.968		1.118		0.848 *		0.835 *		0.835 *		0.850 *		0.824 *		0.813 *	
Gender: Unknown	0.717 *		0.707 *		0.646 *		0.656 *		0.656 *		0.647 *		0.645 *		0.644 *	
Ethnicity: Asian	0.951		0.759		1.184		1.196		1.179		1.188		1.207		1.203	
Ethnicity: Black	0.663 *		0.679		0.605 *		0.608 *		0.604 *		0.617 *		0.606 *		0.599 *	
Ethnicity: Mixed	0.996		1.061		1.106		1.098		1.119		1.117		1.089		1.149	
Ethnicity: Not stated	0.497 **		0.518 **		0.487 **		0.498 **		0.497 **		0.493 **		0.499 **		0.484 **	
OCG	1.630 *		0.097 *		1.725 *		1.543 *		1.721 *		1.719 *		1.680 *		1.703 *	
Drugs	1.153 *		0.848		1.444 **		1.394 **		1.335 *		1.441 **		1.405 **		1.355 **	
Theft and Burglary	1.224 *		1.110		1.205 *		1.191 *		1.194 *		1.196 *		1.191 *		1.176 *	
Robbery	1.750 **		2.495 **		1.483 **		1.427 **		1.435 **		1.469 **		1.307 *		1.293 *	
Degree (co-suspects connections)	1.067 **				1.054 **		1.041 *		1.045 *		1.053 *		1.040 *		1.005	
Proximity score OCG member							1.025 *									
Proximity score drugs suspect									1.034 *							
Proximity score theft/burglary susp.											1.003					
Proximity score robbery suspect													1.050 *			
Proximity score victim of violence															1.156 **	
N	6000		3467		2533		2533		2533		2533		2533		2533	
WAIC	1953.70		1057.90		893.45		892.86		893.35		894.30		892.35		872.52	

Note: Reference categories are Female for gender and White for ethnicity

Table 15 presents the results of a set of Bayesian logistic ridge regression models, estimated first on the full population of at-risk young suspects (Model 1), and then separately for individuals embedded in co-suspect networks (Model 3-8), and for those who are not part of such networks (i.e. individuals who have never been suspected by the police of committing a crime with a co-suspect; Model 2). This modelling strategy allows us to distinguish between individual-level risk factors and the role of relational embeddedness in shaping violent victimisation.

Across the full population of at-risk youth, the likelihood of violent victimisation is shaped by both individual offending behaviour and network embeddedness. Membership in an organised crime group (OCG) is associated with a higher probability of victimisation, and involvement in drugs, theft/burglary, and especially robbery is also linked to increased risk. In contrast, individuals of Black ethnicity or with unstated ethnicity display a lower probability of victimisation, while gender does not emerge as a significant predictor at the population level.

An important finding is that network embeddedness already emerges as a relevant factor, as the positive and statistically significant degree coefficient in Model 1 indicates that simply having co-suspects, rather than being a solo suspect, is associated with a higher likelihood of violent victimisation. In particular, the odds of being victims of violence are 6.7% higher for those who have one co-suspect than for those who don't have any. This is consistent with the idea that victimisation might be driven by exposure to similar risky environments and that victimisation tends to cluster within populations, including at-risk populations.

Crucially, these findings become even more pronounced among individuals embedded in the co-suspect network. Being part of the network is itself a risk factor for violent victimisation, but the risk increases further with the number of connections: each additional co-suspect is associated with a 4.5% increase in the odds of violent victimisation. To put this in concrete terms, a typically connected suspect — with an average of 2.6 co-suspects — faces odds of violent victimisation roughly one and a half times higher than a minimally connected individual with only one connection. Beyond the number of connections, relational proximity (based on shortest-path distances) also matters. Proximity to OCG members and to individuals suspected of involvement in drug-related activities and robbery is positively and significantly associated with violent victimisation, increasing the odds by 3% and 5%, respectively. These results indicate that not only direct connections, but also indirect exposure through the network structure heighten the likelihood of violent victimisation.

Another important finding is that the risk of being a victim of violence increases with proximity to another victim of violence. More specifically, among individuals embedded in the co-suspect network, being one step closer to a victim of violence in the network increases the odds of violent victimisation by 15.9%.

By contrast, among individuals not embedded in the co-suspect network, most crime-related variables display odds ratios at or below one, indicating a substantially lower baseline risk of violent victimisation. Robbery remains the only significant predictor for this group, plausibly

reflecting the intrinsically more violent nature of robbery itself, which involves the use or threat of force against a person.

Turning to knife victimisation (Table 16), the overall patterns broadly mirror those observed for violence with injury, while displaying stronger effects for several key risk factors.⁸ In the model estimated on the entire at-risk youth population, males face substantially higher odds of knife victimisation, as do members of organised crime groups and individuals suspected to be involved in drug activities, robbery, or theft and burglary. Ethnicity effects are also more pronounced than for violence with injury overall, with Asian and Black individuals exhibiting increased odds of knife-related victimisation (compared to White individuals, the reference category). As for victims of violence in general, also in the case of knife-related violent victimisation the degree of network embeddedness remains a central risk factor.

An important finding is that, among the at-risk youth population, the degree coefficient is positive and statistically significant, indicating that simply having one co-suspects is associated with an increase in the odds of knife victimisation of approximately 11%.

Among individuals embedded in the co-suspect network, this association becomes even stronger. Degree — that is, the number of suspected co-offending connections an individual has within the network — remains a robust predictor across all models, suggesting that not only network membership but also the extent of embeddedness matters: the more connected an individual is, the higher their risk of knife victimisation.

In addition to direct connectivity, relational proximity plays an important role also in the case of knife violent victimisation. Greater proximity to individuals suspected to being involved in drug-related activities, theft and burglary, and especially robbery is associated with significantly higher odds of knife victimisation. In substantive terms, a one-unit increase in proximity corresponds to an increase in the odds of knife victimisation of around 6% for theft and burglary, 11% for drug-related activity, and 14% for robbery. This further highlights the role of exposure to high-harm offending environments in shaping knife-related victimisation risk.

Another important finding is that the risk of being a victim of knife violence increases with proximity to a victim of violence with injury. More specifically, every additional step in proximity increases the odds of knife violent victimisation by 16.9%. Once more, this is consistent with the idea that victimisation might be driven by exposure to similar risky environments, and that violence — particularly knife violence — tend to cluster even within at-risk populations.

⁸ A note of caution: results for knife violence should be interpreted having in mind that the set of knife victims in our dataset is relatively small. Therefore, it will be important to run the same analyses on larger populations to assess the robustness of our findings. Results for ethnicity should be interpreted with caution given the high number of missing data for this variable.

Table 16. Logistic regression models, knife-related violent victimisation

VICTIMS OF VIOLENCE WITH KNIFE															
Parameter	All		Not in network	In network		In network		In network		In network		In network		In network	
(Intercept)	0.004		0.007	0.003		0.003		0.003		0.003		0.003		0.002	
Gender: Male	1.982	**	1.103	2.062	*	2.053	*	1.952	*	2.022	*	1.933	*	2.086	*
Gender: Unknown	0.827		0.903	0.477		0.481		0.483		0.490		0.492		0.455	
Ethnicity: Asian	2.168	*	1.044	2.868	*	2.839	*	2.740	*	2.968	*	2.953	*	3.146	*
Ethnicity: Black	1.732	*	1.164	1.139		1.145		1.097		1.135		1.097		1.174	
Ethnicity: Mixed	0.179	*	0.826	0.175	*	0.195	*	0.201	*	0.207	*	0.184	*	0.162	*
Ethnicity: Not stated	1.121		0.992	0.993		0.985		1.009		1.008		1.022		1.052	
OCG	2.435	*	0.734	2.230	*	2.331	*	2.151	*	2.171	*	2.055	*	2.075	*
Drugs	1.936	**	1.001	2.832	**	2.826	**	2.358	**	2.732	**	2.647	**	2.740	**
Theft and Burglary	1.511	*	1.090	1.340		1.351		1.333		1.198		1.306		1.310	
Robbery	2.511	**	1.334	2.151	**	2.138	**	1.995	**	2.040	**	1.648	*	1.912	*
Degree (co-suspects connections)	1.109	**		1.109	**	1.111	**	1.092	**	1.096	**	1.081	*	1.070	*
Proximity score OCG member						0.991									
Proximity score drugs suspect								1.115	**						
Proximity score theft/burglary susp.										1.061	*				
Proximity score robbery suspect												1.139	**		
Proximity score victim of violence														1.169	**
N	6000		3467	2533		2533		2533		2533		2533		2533	
WAIC	359.49		165.00	196.25		196.49		194.37		195.44		193.71		191.85	

Note: Reference categories are Female for gender and White for ethnicity

By contrast, among individuals not embedded in the co-suspect network, most predictors are not statistically significant. This further underscores the importance of network embeddedness. Overall, these results indicate that knife-related victimisation is not evenly distributed across the at-risk youth population, but is disproportionately concentrated among individuals who are embedded in co-suspect networks and who are exposed to serious and violent offending activity. This pattern highlights the importance of network-based mechanisms in shaping knife harm and supports the need for prevention strategies that move beyond individual-level risk factors.

A very small number of studies have examined how network proximity shapes victimisation risk. Papachristos, Braga, Piza and Grossman (2015) show that both direct and indirect links to gang members within co-offending networks significantly increase the probability of becoming a gunshot victim, while Papachristos, Wildeman, and Roberto (2014) and Papachristos and Wildeman (2014) demonstrate that proximity to gunshot and homicide victims within one's network heightens the risk of violent victimisation. However, these studies focus on gunshot injuries, cover populations of all ages, and are set in contexts — such as Chicago — characterised by exceptionally high levels of violence and widespread weapon availability.

Our study extends this line of inquiry to a UK context, focusing specifically on at-risk youth in a setting where violence, while serious, operates under very different conditions. We contribute by demonstrating that network proximity shapes both general and knife victimisation risk among at-risk youth, that indirect exposure through shortest-path distances matters, and that among non-networked youth almost no individual characteristic significantly predicts victimisation — suggesting that the network is central to how victimisation risk materialises in this population.

3.3 Suspect-victim pairs

Next, we turn our focus on pairs of suspect and victim to offer a descriptive joint analysis of the characteristics of both suspects and victims. Our aim is to analyse specifically the victimisation patterns of youth victims, hence we only consider pairs in which victims are aged 18 or below. In this analysis, we first consider all suspect-victim pairs that include suspects of all ages and then we restrict the sample to youth suspects only. Victims are aged 18 or below in both sets of analysis.

To jointly explore characteristics of suspects and offenders linked by a victimisation relation, we compute the percentage of pairs that exhibit a given characteristic relative to the total number of pairs. It is important to note that this analysis does not take into account the intensity of victimisation as captured by the number of times the same suspect has victimised the same victim. Instead, it is focused on individual-level pairs: each offender–victim pair is counted only once, even if multiple events occurred between the same two individuals. As a result, a

pair may be associated with many victimisation events, but it still contributes only one entry to the analysis.⁹

This analysis explores the extent to which violence exhibits similarity between victims and offenders.

Table 17. Victim-offender similarity: gender, age and OCG membership, all suspects

	All suspects	Youth victims	Percentage
Age	Young	Young	68.25%
	Adult	Young	31.75%
Gender	Male	Male	53.48%
	Male	Female	14.81%
	Female	Male	6.33%
	Female	Female	19.70%
OCG	OCG	OCG	0.24%
	OCG	No-OCG	2.12%
	No-OCG	OCG	0.60%
	No-OCG	No-OCG	97.04%

Table 18. Victim-offender similarity: gender, age and OCG membership, youth suspects

	Youth suspects	Youth victims	Percentage
Gender	Male	Male	61.28%
	Male	Female	12.18%
	Female	Male	4.35%
	Female	Female	22.19%
OCG	OCG	OCG	0.35%
	OCG	No-OCG	1.70%
	No-OCG	OCG	0.29%
	No-OCG	No-OCG	97.65%

Age similarity is pronounced in our data, with 68.2% of pairs belonging to the same-age group, with youth victims predominantly being victimised by suspects who are also youth (Table 17). This suggests that victimisation often occurs within age-bounded social networks or contexts. However, approximately one-third of victimisation events involve adult suspects victimising youth victims.

⁹Taking into account intensity would have skewed the results because a small number of chronic offender-victim pairs with numerous repeat incidents would disproportionately influence the observed patterns, obscuring the broader joint characteristics of victimisation relationships across the population.

As for gender, the majority of victimisation dyads involve two male individuals (53.48%). Overall, we observe a strong tendency towards gender similarity, with 70% of violent pair occurring between individuals of the same gender (either male–male or female–female). This percentage increases to approximately 80% when considering only youth suspects, driven by increases in both male-on-male and female-on-female violence within this subgroup (Table 18). Male-on-female violence accounts for approximately 15% of pairs in the broader sample and decreases slightly to 12% when restricting the analysis to youth suspects. Female-on-male violence represents a smaller proportion, accounting for 6% and 4% of pairs in the full and youth-only samples, respectively.

Although OCG members are relatively rare in the violence network (97% of pairs do not involve an OCG member on both sides of the violent pair), when an OCG member is involved in a violent incident, they are 3.5 times more likely to occupy the suspect role than the victim role. Despite the small number of OCG members in our sample, we do observe instances of violence within the OCG milieu, though our data do not permit us to distinguish between violence occurring within the same OCG and violence between members of different OCGs.

Table 19. Victim-offender similarity: ethnicity, all suspects and young suspects

		Young victims of violence				
		White	Black	Asian	Mixed	Other
All suspects	White	80.76%	1.99%	2.41%	1.49%	0.42%
	Black	3.73%	0.91%	0.08%	0.66%	0.17%
	Asian	2.65%	0.00%	0.91%	0.25%	0.08%
	Mixed	1.66%	0.00%	0.17%	0.17%	0.00%
	Other	1.33%	0.00%	0.08%	0.00%	0.08%

		Young victims of violence				
		White	Black	Asian	Mixed	Other
Young suspects	White	80.88%	1.82%	3.12%	1.95%	0.39%
	Black	3.51%	0.78%	0.13%	0.91%	0.13%
	Asian	1.95%	0.00%	0.65%	0.26%	0.00%
	Mixed	1.82%	0.00%	0.26%	0.26%	0.00%
	Other	1.04%	0.00%	0.13%	0.00%	0.00%

Note: Ethnicity “Not stated” is not considered in the analysis.

With respect to ethnicity (Table 19), there is a strong similarity within pairs, with 83% of pairs involving suspects and victims of the same ethnicity. This level remains consistent when

restricting the analysis to youth suspects. In both samples, the majority of offender–victim pairs (more than 80%) involve individuals of White ethnicity on both sides. When examining inter-ethnic offender–victim pairs, the most frequent combinations involve White individuals paired with individuals of other ethnicities, either as offenders or as victims.¹⁰

The pair-wise analysis of suspect-victim characteristics suggests several important implications for intervention.

Age patterns: Findings provide critical evidence for a dual approach to violence reduction strategies. The high level of age similarity indicates that age-specific peer interventions are essential, targeting the social contexts where young people interact—schools, youth clubs, neighbourhoods, and online spaces. However, the substantial proportion of adult-on-youth violence reveals a distinct cross-generational victimisation pattern that potentially requires different intervention strategies, such as enhanced safeguarding measures and targeted enforcement against adults who exploit or victimise young people. Further work is needed to better understand the age gap between suspects and victims within adult-on-youth violence.

Gender patterns: While male-on-female violence is serious and requires continued attention, 80% of youth violence occurs between same-gender individuals. This suggests the need to develop interventions that better address these same-gender victimisation dynamics. Male-on-female violence likely represents a distinct pattern with different underlying motivations. Further qualitative research exploring the contexts and drivers of these incidents is essential to identify appropriate specialised interventions. The lower but non-negligible rate of female-on-male violence (6% overall, 4% among youth) also warrants further investigation.

OCG involvement: Although OCG members remain rare in the violence network, they are disproportionately perpetrators rather than victims. This suggests that targeting OCG members for intervention may have an outsized impact on violence dynamics, as they appear to drive violence rather than being caught up in it.

3.4 Limitations

This study has a number of limitations that should be borne in mind when interpreting the findings. First, the data are based exclusively on police records, which means that only detected and recorded crime is captured. Offences that were not reported to or recorded by the police are therefore absent from the analysis, and the networks reconstructed here also reflect police activity. The dataset is limited to individuals who have come to police attention, meaning it does not capture the full universe of victims and offenders.

¹⁰ Although pair-wise analyses are less affected by missing data, readers should note that the ethnicity variable contains a high number of missing values.

Second, the cross-sectional design cannot establish the direction of effects. Further work should be carried out to understand the motivations underpinning the use of violence, and to ascertain whether more violence-inclined young people are more likely to become embedded in networks of offending or at-risk subcultures (thus exploring the potential reverse causality mechanism) through longitudinal quantitative designs and qualitative interviews with affected individuals and practitioners.

Third, police event data only partially capture young individuals' daily experiences, and it would be advisable to integrate police records with other non-police sources of data, e.g. youth services, school records and health data. Fourth, the data covers a single force area, and it remains an open question whether network dynamics would differ in larger urban settings such as London or Birmingham. Future work should also replicate our analysis in other settings.

Finally, the high level of missing data on the ethnicity variable limits the conclusions that can be drawn from analyses involving this characteristic, and further work using alternative and non-police sources of data would be advisable.

3.5 Conclusions: A relational Approach to Youth Violence

Network (relational) analysis offers a number of insights that more traditional individual-level approaches would not have provided. Traditional analyses in this area typically examine young people in isolation, identifying individual-level risk factors — such as age, gender or prior offending — associated with violence. While valuable, this approach misses a fundamental feature of youth violence: it is deeply social and relational.

This study has demonstrated that a young person's position in a co-suspect network is an independent and powerful predictor of both violent offending and violent victimisation, effectively giving rise to two distinct risk profiles among at-risk youth: those embedded in a co-suspect network and those who are not. Critically, by modelling network distances, the analysis has also captured not just who a young person is directly connected to, but how close they are — through others — to violence, robbery, drugs, or organised crime. This matters: for example, proximity to a suspect who has also been a victim of violence increases the odds of committing violence or being victim of violence.

The study has also shown that violence may be “contagious” — spreading through social connections in ways that only become visible when relationships are modelled explicitly, although further work on the exact mechanisms underlying the spread of violence is needed. Contagion is a catchy metaphor, but it tells only part of the story: it is the outcome of underlying mechanisms such as differential association and social learning, retaliation dynamics, coercion by peers or adults, and reputational pressures that may normalise or incentivise violent behaviour. In our study, these mechanisms are necessarily captured together under the broader

notion of exposure to risky environments, as our data do not allow us to disentangle them further; qualitative follow-up work would be particularly valuable in this respect.

Our relational study has further enabled the identification of a specific high-risk subgroup: the top 5% most connected youth show rates of violence, knife involvement, and drug offending far exceeding the broader at-risk population — a group that individual-level analysis would not have identified as structurally distinct. Also of note, among at-risk young people with no network ties, no individual or offending characteristic significantly predicts violent offending, and almost none significantly predicts violent victimisation, underscoring that the network is not merely a correlate of risk but central to how risk operates.

The study has also examined whether general violence and knife-violence clusters within specific parts of the network, and whether individuals with similar characteristics — such as age, gender, or ethnicity — tend to establish more violent connections. This has revealed the internal structure of risk in ways that individual-level analysis cannot, showing that serious violence is not randomly distributed across the network but concentrated within specific segments.

Additionally, the study has incorporated a geographical dimension, showing that youth violence and co-suspect networks are predominantly local: the vast majority of youth suspected of violence operated within a single area, and the network itself mirrors this spatial concentration, with suspects from different areas forming distinct, largely separate clusters.

Based on these findings, our relational study generates actionable targets for intervention beyond what individual-level analysis would have provided. These are presented in the next section. However, it is important to stress that our relational analysis integrates, rather than substitutes for, individual- and area-level analyses: relational factors should be considered alongside the individual and contextual risk factors that practitioners are already familiar with.

4. Implications and Recommendations for Policy and Practice

This study has explored the mechanisms — and related risk factors — underlying suspected youth violent offending and violent victimisation, drawing on 42 months of crime event data recorded by Cambridgeshire Constabulary. Based on these findings, we discuss 16 policy and practice implications.

The following network-informed strategies are relevant to both the prevention of youth violent offending and the reduction of youth violent victimisation:

1. Intervening at the first signs of **network embeddedness, regardless of offence seriousness**.
2. Adding **network-based factors to risk scoring tools** based on either direct connections (degree centrality) or network proximity to high-risk individuals.
3. Prioritising high-degree '**super-connected**' youth for intervention programs.
4. Targeting proximity to specific suspects within networks (e.g. organised crime or robberies) to **disrupt particularly harmful exposure**.
5. Identifying young people connected to **suspects who have also been victims of violence**, whether peers or adults, offers opportunities for early intervention.
6. Special attention should be paid to **age gaps** in co-suspects relationships, as these may expose young people to more serious criminal activity and violence.
7. Importance of focusing on the **drug-knife-violence nexus**.

For youth violent victimisation, the study additionally suggests:

8. Breaking down institutional separations between 'victim' and 'suspect' within at-risk youth with an integrated case management approach, as **victim-offender overlap** grows sharply with crime severity.
9. Recognising that **proximity to a victim of violence** is a strong risk factor for knife victimisation **among youth who have also been a suspect in an unrelated event**.
10. Adopting **network-aware knife violence strategies**, as knife violence victimisation is **disproportionately concentrated** among youth suspects embedded in co-suspect networks.
11. Peer-group interventions should be designed reflecting **same-gender dynamics**. Male-focused programmes are certainly crucial, but the substantial level of female-on-female violence should not be overlooked.
12. Developing a distinct response for **adult-on-youth violence**. One-third of violent pairs involving adult suspects victimising youth likely reflects different dynamics compared to youth-on-youth violence — potentially including exploitation.

13. Targeting **OCG members as drivers of violence**. Although OCG-linked individuals are a small group, they are disproportionately in the perpetrator role.

14. Tracking changes in **network position as an outcome measure** to assess whether interventions successfully reduce an individual's network embeddedness (level of connectivity) as a way to decrease the risk of future victimisation.

Finally, it is suggested to build capacity around:

15. Systematic data collection and **network mapping capabilities** not only within police but also within youth services to inform proactive intervention before violence occurs.

16. Develop safe, proportionate, and ethical **procedures to share network intelligence** across criminal justice agencies, youth services, the education sector, and community organisations. Multi-agency responses should draw on multiple sources of information about individuals' network exposure and position.

While the analysis is limited to police-recorded crime events, the network-informed approach discussed in this study can also be applied by youth services and other agencies beyond the police to support the prevention of youth involvement in violence.

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Appendix

4 A1. Highly connected individuals: betweenness centrality

An alternative way to assess centrality is through the betweenness centrality measure. This measure captures the extent to which an individual lies on the shortest paths connecting other individuals in the network, thereby reflecting their potential brokerage—or “bridging”—role between otherwise weakly connected clusters or individuals (Wasserman and Faust 1994). In doing so, betweenness centrality indicates an individual’s potential to influence the flow of information, resources, or opportunities across the network.

A total of 172 young individuals fall within the top 5% of the overall betweenness centrality distribution, out of 468 individuals in this top percentile across all ages. This group of “super-bridging” youth is overwhelmingly male: 89.5% are male, compared to 68% in the youth population overall (Table A1). They are also disproportionately involved in serious offending. Nearly half are identified as knife carrying (47%, versus 8% among all youth), around half are suspected to be involved in drug-related offences, 57% in theft or burglary, and 69% in violent offences. In addition, approximately 10% are identified as members of organised crime groups (OCGs), a strikingly high share given that only 0.75% of the youth population overall is identified as a member of an OCG. Taken together, these patterns indicate that this small group—representing roughly 2% of all youths—exhibits a markedly elevated risk profile. Compared to the at-risk youth population as a whole, “super-bridging” youth are far more likely to be male and to be involved in drug offences, as well as theft, burglary, or robbery. Youth from ethnic minority backgrounds are also slightly overrepresented within this group.

Table A1. Highly-connected individuals, betweenness centrality

Variable	Category	All	Top 5% betweenness all	Top 5% betweenness youth
		N 6000	468	172
Gender	Male	68.07%	84.40%	89.53%
	Female	26.98%	14.96%	8.72%
	Unknown	4.95%	0.64%	1.74%
Ethnicity	White	86.11%	78.67%	78.42%
	Black	6.09%	9.33%	10.79%
	Asian	4.34%	8.00%	5.76%
	Mixed	2.10%	2.13%	2.88%
	Other	1.36%	1.87%	2.16%
Knife carrying	Yes	8.02%	43%	47.09%
OCG membership	Yes	0.75%	10.68%	10.47%
Drug-related crimes	Yes	16.83%	52.14%	50.00%
Theft/burglary-related crimes	Yes	16.57%	67.96%	56.98%
Robbery-related crimes	Yes	5.05%	37.61%	40.70%
Violence	Yes	24.35%	59.83%	69.19%

Finally, are high-betweenness youth more likely to engage in violence? Youth with high betweenness centrality are substantially more likely to be suspected of violent behaviour than those with lower betweenness. Nearly 60% of high-betweenness youth are suspected of involvement in violence, compared to 25.8% among other youth. A similar pattern holds for knife-related violence: 16.2% of high-betweenness youth are suspected of violence involving a knife, versus 3.1% among the rest. These differences are statistically significant, with the null hypothesis of no difference rejected at the 1% level in t-tests.

When looked through the betweenness centrality scores, youth suspected of involvement in violent incidents possess higher betweenness centrality than youth involved in non-violent crime. The mean betweenness score is substantially higher among youth involved in violence and shows greater variability.¹¹ Both Welch's t-test and the Wilcoxon rank-sum test reject the null hypothesis of no difference, indicating a statistically significant difference in betweenness centrality between youth involved in violence and youth involved in non-violent crime.

5 A2. Youth offending: sensitivity and specificity analysis

To understand how well individual characteristics serve as indicators of violent behaviour, we rely on sensitivity and specificity. These metrics represent a standard approach for evaluating the distribution of risk factors across different populations – in our case, violent and non-violent youth populations. Sensitivity measures the proportion of youth suspected of violence who possess a given characteristic, when that characteristic is treated as a screening flag for violence. A high sensitivity therefore indicates that the given characteristic is common among youth suspected of violence, meaning that the characteristic (factor) is able to effectively capture a large share of individuals who commit violence. Formally, it is defined as:

$$\text{Sensitivity} = \frac{\text{true positives}}{\text{true positives} + \text{false negatives}}.$$

Specificity, by contrast, measures the proportion of youth suspected of non-violent crime who do not possess the given characteristic. A high specificity indicates that the characteristic (factor) is largely absent among at risk non-violent youth, meaning that it seldom flags individuals who do engage in violent behaviour. The specificity is defined as:

$$\text{Specificity} = \frac{\text{true negatives}}{\text{true negatives} + \text{false positives}}.$$

Taken together, sensitivity and specificity provide complementary information about how well a characteristic (factor) distinguishes between violent and non-violent youth, when the factor is treated as a screening indicator. In particular, a factor exhibiting both high sensitivity and specificity would be strongly associated with violence since it would be prevalent among youth suspected of violence and largely absent among at risk youth not suspected of violence,

¹¹ Mean betweenness 0.0007 (violent youth) vs. 0.00001 (non-violent); standard deviation: 0.0033 vs 0.0006. Betweenness centrality values are often skewed towards zero. They are not directly interpretable but only used to rank order.

indicating strong screening performance. Such a factor would capture a large share of violent cases while rarely flagging non-violent individuals. By contrast, a factor with low sensitivity but high specificity would rarely flag youths suspected of violence but would also do so very infrequently among youth not suspected of violence.

These metrics are derived from a 2x2 contingency table, also called a confusion matrix, which cross-tabulates the presence or absence of a given factor against violent and non-violent status. The matrix distinguishes between true positives (violent cases with the given factor/characteristic), false positives (non-violent cases with the factor/characteristic), true negatives (non-violent cases without the given factor/characteristic), and false negatives (violent cases without the given factor/characteristic).

Table A2. Sensitivity/specificity analysis: individual factors

		Violence		Violence with knife	
Variable	Category	Sensitivity	Specificity	Sensitivity	Specificity
Gender	Male	0.675	0.324	0.871	0.329
	Unknown	0.051	0.943	0.036	0.944
	Female	0.274	0.733	0.094	0.727
Ethnicity	Asian	0.018	0.977	0.036	0.979
	Black	0.030	0.972	0.086	0.973
	Mixed	0.014	0.990	0.022	0.99
	White	0.401	0.582	0.367	0.585
	Not stated	0.537	0.479	0.489	0.474

		Violence		Violence with knife	
Variable	Category	Sensitivity	Specificity	Sensitivity	Specificity
Crime type	Robbery	0.097	0.964	0.266	0.955
	Drugs	0.157	0.828	0.439	0.838
	Theft and Burglary	0.162	0.833	0.281	0.837
OCG flagged	Yes	0.014	0.994	0.058	0.994

Note: sensitivity and specificity are computed on the entire youth population (in network and not in the network).

Tables A2 and A3 report sensitivity and specificity measures for individual and relational factors, respectively, when these characteristics are treated as screening indicators for violence with injury and knife-related violence.

Overall, most individual characteristics exhibit low sensitivity and high specificity, indicating that they flag only a small proportion of youth suspected of violence while remaining largely absent among at risk youth not suspected of violence (i.e., youth suspected of non violent crime). For violence with injury, sensitivity values for robbery and organised crime group

membership are particularly low (9.7% and 1.4%, respectively) while specificity exceed 96% in both cases. However, sensitivity alone does not capture the informational value of these indicators for the individuals they do identify. Among youth who have a history of robbery or organised crime group membership, more than 44% are involved in violence with injury, indicating that these characteristics, although rare, are strongly concentrated among youth suspected of violence. Thus, while uncommon, these indicators are highly informative when observed, and robbery involvement and OCG membership may represent rare but meaningful risk indicators.

By contrast, demographic characteristics such as gender and ethnicity, when used in isolation, offer more limited predictive value. For example, being male displays high sensitivity for both violence with injury (67.5%) and knife-related violence (87.1%), but very low specificity (32.4% and 32.9%, respectively), reflecting the fact that being male captures a large share of violent individuals, but most non-violent youth suspects are also male. At the same time, specificity remains consistently high across all factors, indicating that most non-violent individuals are correctly classified.

Table A3. Sensitivity/specificity analysis: first degree connections (co-suspects) characteristics

Variable	Category	Violence		Violence with knife	
		Sensitivity	Specificity	Sensitivity	Specificity
Co-suspects characteristics	OCG membership	0.060	0.960	0.121	0.956
	Drugs	0.360	0.713	0.667	0.703
	Theft and Burglary	0.447	0.579	0.667	0.580
	Robbery	0.298	0.835	0.596	0.806
	Knife carrying	0.348	0.801	0.919	0.778

Note: sensitivity and specificity are computed on the youth population in network.

Among youth suspects involved in violence with injury, with at least one co-offending tie, being connected to an individual identified as knife carrying, robbery or drug-related suspected offending capture a large share of youth suspected of violence, with sensitivities of 34.8%, 29.8%, and 36% respectively, while retaining specificity levels above 70%.

Connections to individuals identified as organised crime members, by contrast, exhibit very low sensitivity (6.0%) but extremely high specificity (96.0%). Although this indicator identifies only a small fraction of youth suspected of violence, more than 43% of youth exposed to OCG-involved co-suspects are themselves involved in violence with injury, indicating that OCG exposure, while rare, is strongly concentrated among violent youth and represents a highly selective relational risk indicator. Compared with individual factors, relational indicators exhibit slightly lower specificity overall, with values ranging from 57.9% to 96.0%. This pattern indicates that relational indicators identify broader subsets of at-risk youth, albeit with a slight increase in false positives compared with individual characteristics.

When focusing on the much smaller group of youth suspected of involvement in knife-related violence, relational factors prove even more informative. Being connected to an individual flagged for knife carrying yields a very high sensitivity (91.9%) alongside high specificity (77.8%). This reflects the fact that most youth suspected of knife violence are embedded in networks where knife carrying is present, even though such exposure is not exclusive to this group. In other words, while not all exposed youth are knife-violent, the vast majority of knife-violent youth are captured by this indicator.

Connections to OCG members, by contrast, exhibit low sensitivity (12.1%) and high specificity (95.6%). Among youth connected to OCG-involved individuals, only around 10% are involved in knife-related violence, while the absence of such connections corresponds to a very low likelihood of knife violence. This suggests that, for knife-related violence, OCG exposure is primarily informative in ruling out risk when absent rather than identifying elevated risk when present, a pattern that likely reflects the rarity of both knife violence and OCG involvement.

Sensitivity and specificity measures based on direct co-suspect characteristics should be interpreted with caution. For most offence-related indicators, including knife carrying, co-offender characteristics are assigned on the basis of shared co-offending events. Consequently, these measures may reflect direct co-involvement in a common event rather than independent exposure to risk through social and offending ties. This limitation applies to both violence with injury and knife-related violence and affects all event-based relational indicators, with the exception of organised crime group (OCG) membership, which is a person-specific attribute rather than an event-based characteristic.

6 A3. Youth victimisation: sensitivity and specificity analysis

To further examine the relationship between specific individual and relational risk factors and the likelihood of being a victim of violence with injury or knife-related violence, we present a set of sensitivity and specificity analyses. To make our results consistent across different sets of factors – individual and relational – we focus our analysis on young individuals who also have been suspects of a crime (all youth suspects, $N = 6,000$). This is a set of young people at higher risk. Among this set of youth suspects, some are also victims of violence. We then assess which factors are able to screen among this broader set of at-risk young individuals those who are at higher risk of being a victim of violence with injury in general and knife violence.

As a reminder, these metrics represent a standard approach for evaluating the distribution of risk factors across different populations. Specifically, sensitivity measures the proportion of youth victims of violence with injury (or knife-related violence) who possess a given characteristic, when that characteristic is treated as a screening flag for violent victimisation. A high sensitivity, therefore, indicates that the given characteristic is common among youth victims of violence, meaning that it is able to effectively capture a large share of individuals who are victimised. Formally, it is defined as:

$$Sensitivity = \frac{true\ positives}{true\ positives + false\ negatives}$$

Specificity, by contrast, measures the proportion of youth non-victims of violence who do not possess the given characteristic. A high specificity indicates that the factor is largely absent among youth not victims of violence, meaning that it seldom flags individuals who are victims of violence. The specificity is defined as:

$$Specificity = \frac{true\ negatives}{true\ negatives + false\ positives}$$

Taken together, sensitivity and specificity provide complementary information about how well a factor distinguishes between violent victimisation and non-violent victimisation. In particular, a factor exhibiting both high sensitivity and specificity would be strongly associated with violent victimisation since it would be prevalent among youth violent victims and largely absent among non-victims, indicating strong screening performance. Such a factor would capture a large share of violent victimisation cases while rarely flagging individuals non-violently victimised. By contrast, a factor with low sensitivity but high specificity would rarely flag youth victims of violence, while the absence of the factor would frequently flag youth non-victims of violence. Finally, a factor with high sensitivity but low specificity would capture a large proportion of youth victims of violence but would also flag many youth not victims of violence.

These metrics are derived from a 2x2 contingency table, also called a confusion matrix, which cross-tabulates the presence or absence of a given factor against violent and non-violent victimisation status. The matrix distinguishes between: true positives (violent victimisation cases with the given factor), false positives (non-violent victimisation cases with the factor), true negatives (non-violent victimisation cases without the given factor), and false negatives (violent victimisation cases without the given factor).

Table A4. Sensitivity/specificity analysis: individual factors

		Victim of violence		Victim of violence with knife	
Variable	Category	Sensitivity	Specificity	Sensitivity	Specificity
Gender	Male	0.695	0.327	0.905	0.327
	Unknown	0.038	0.943	0.027	0.944
	Female	0.267	0.731	0.068	0.728
Ethnicity	Asian	0.030	0.979	0.068	0.979
	Black	0.030	0.971	0.081	0.972
	Mixed	0.017	0.990	0.000	0.989
	White	0.570	0.604	0.351	0.585
	Not stated	0.352	0.455	0.500	0.475

		Victim of violence		Victim of violence with knife	
Variable	Category	Sensitivity	Specificity	Sensitivity	Specificity
Crime type	Robbery	0.104	0.956	0.257	0.952
	Drugs	0.216	0.837	0.432	0.835
	Theft and Burglary	0.224	0.841	0.351	0.837
OCG membership	Yes	0.019	0.994	0.068	0.993

Table A5. Sensitivity/specificity analysis: co-suspects characteristics

		Victim of violence		Victim of violence with knife	
Variable	Category	Sensitivity	Specificity	Sensitivity	Specificity
Co-suspects characteristics	OCG membership	0.081	0.958	0.156	0.955
	Drugs	0.414	0.703	0.689	0.695
	Theft and Burglary	0.511	0.581	0.711	0.575
	Robbery	0.319	0.806	0.600	0.798
	Knife carrying	0.381	0.769	0.644	0.758

The analysis shows that both gender and even more so ethnicity are of limited value. For instance, being male identifies a large proportion of victims (sensitivity = 0.695 for violence; 0.905 for knife violence), but also captures many non-victims (specificity = 0.327 in both cases). This means male gender is a high-coverage but low-precision indicator: it is useful for defining broad prevention populations, but unsuitable for targeted enforcement or intervention strategies. Female and “unknown” categories show high specificity but very low sensitivity, indicating they are poor identifiers of risk. Ethnicity characteristics display consistently very high specificity but very low sensitivity across categories. For example, Asian, Black, and Mixed categories all show specificity above 0.97 but sensitivity below 0.08 for both violence and knife-related violence. This indicates that ethnicity does not function as an effective risk identification tool. Risk appears to be crime-related and relational rather than demographic, reinforcing the importance of network-based and behavioural indicators rather than demographic indicators.

Individual crime-related factors (robbery, drugs, theft/burglary) show high specificity, meaning the absence of the factor tends to (correctly) identify the absence of violent victimisation, but overall low-to-mid sensitivity, meaning the presence of the factor alone correctly identifies between 10% and 22% of victims of violence. Sensitivity is higher for knife-violence victims, with drug-related crime involvement correctly identifies 43.2% of cases of knife victimisation (sensitivity = 0.432; specificity 0=0.835). Organised crime membership has extremely high specificity (>0.99) but very low sensitivity (<0.07), reflecting the small number of young individuals who are members of an organised crime group (OCG).

With respect to the characteristics of a youth's co-suspects, they show substantially higher sensitivity while retaining moderate specificity, especially for knife violence:

- Co-suspect drug involvement (sensitivity = 0.689)
- Co-suspect theft and burglary (sensitivity = 0.711)
- Co-suspect robbery (sensitivity = 0.600)
- Co-suspect knife-carrying (sensitivity = 0.644)

These results indicate that network exposure is a strong screening tool. In policy terms, this suggests that serious violence, especially knife-related violence, has a strong network element in the form of network-embedded risk, where exposure to high-risk peers through co-offending substantially increases vulnerability.

The sensitivity–specificity patterns support a tiered intervention approach. High-specificity, low-sensitivity indicators (such as OCG membership) are suited to intensive, targeted interventions, while high-sensitivity, low-specificity indicators (such as male gender) support broad prevention strategies. Indicators with more balanced profiles, particularly individual and relational crime-related factors, provide the strongest basis for targeted prevention and safeguarding.

The higher sensitivities associated with co-suspect variables in knife-related violence further indicate that knife harm is structurally concentrated within specific network structures, underscoring the need for network-focused rather than purely individual-level responses.

7 A4. Age of onset and termination of recorded incidents, youth suspects

Leveraging the longitudinal nature of the data, we can examine the persistence (continuity) of offending over time, using the age at first recorded incident and the age at last recorded incident within the observation window (Table A6).

Each cell shows the percentage of individuals who committed their first crime at the age indicated in the row and their last crime at the age indicated in the column. For example, 60% of individuals committed both their first and last crimes at age 10, while the remaining 40% continued offending beyond that age. The percentage of individuals who have their age at last crime being equal to their age at first crime is the lowest among individuals who have committed their first crime at age 13, making them a particularly vulnerable population. It is important to note that this analysis is subject to limitations.

Table A6. Age of onset and termination of recorded incidents, youth suspects

	AGE AT LAST CRIME															
	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
AGE AT FIRST CRIME	10	0.60	0.12	0.25	0.04	0	0	0	0	0	0	0	0	0	0	0
	11	0	0.61	0.18	0.16	0.06	0	0	0	0	0	0	0	0	0	0
	12	0	0	0.64	0.16	0.11	0.08	0	0	0	0	0	0	0	0	0
	13	0	0	0	0.49	0.16	0.24	0.11	0	0	0	0	0	0	0	0
	14	0	0	0	0	0.58	0.14	0.24	0.04	0	0	0	0	0	0	0
	15	0	0	0	0	0	0.56	0.22	0.12	0.1	0	0	0	0	0	0
	16	0	0	0	0	0	0	0.64	0.21	0.12	0.04	0	0	0	0	0
	17	0	0	0	0	0	0	0	0.52	0.2	0.15	0.13	0	0	0	0
	18	0	0	0	0	0	0	0	0	0.63	0.13	0.18	0.06	0	0	0
	19	0	0	0	0	0	0	0	0	0	0.66	0.15	0.12	0.07	0	0
	20	0	0	0	0	0	0	0	0	0	0	0.67	0.13	0.12	0.07	0
	21	0	0	0	0	0	0	0	0	0	0	0	0.65	0.19	0.09	0.07
	22	0	0	0	0	0	0	0	0	0	0	0	0	0.67	0.16	0.1
	23	0	0	0	0	0	0	0	0	0	0	0	0	0	0.73	0.12
	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.83
	25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1

Firstly, it is not based on a longitudinal follow-up of individuals but instead relies on administrative records observed within a fixed four-year window. As a result, ages at first and last recorded involvement do not necessarily correspond to true onset or cessation. The estimates are subject to left- and right-censoring, as earlier or later incidents may fall outside the observation period. Secondly, individuals might commit a crime outside the jurisdiction of the Cambridgeshire police and be recorded as no longer active in our analysis. These limitations, however, are somewhat less concerning for underage individuals, since the scope for substantial unobserved prior involvement is constrained by age, and the observation window captures a relatively large share of their involvement period.