Adverse and positive childhood experiences and their associations with children's involvement in violence: analyses of data from the Millennium Cohort Study

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Acknowledgements

About the research team

The research team is based at the University College London (UCL) Centre for Longitudinal Studies (CLS), a leading centre for data and research on longitudinal studies. CLS is home to four of the UK national cohort studies, including the Millennium Cohort Study (MCS). The researchers have extensive experience in accessing, managing and carrying out analyses using MCS data, including research on adolescent crime and violence and linkage with geographical data.

Dr Aase Villadsen (a.villadsen@ucl.ac.uk) is a Senior Research Fellow with a DPhil in Social Intervention from Oxford University. She has worked extensively with the data from the MCS, examining especially the family environment and its association with various child and adolescent outcomes.

Dr Nicolas Libuy is a Senior Research Fellow with a PhD in Health Economics from the University College London. He has experience in linking geospatial data to MCS to evaluate how the physical environment affects children's outcomes.

Professor Emla Fitzsimons is a Professor of Economics and Director of the MCS, a role she has held since 2013. She is particularly interested in using longitudinal data and quasi-experimental methods to better inform policy and decision-making.

Further acknowledgements

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Executive summary

About the project

This project examined whether adverse childhood experiences (ACEs), positive childhood experiences (PCEs) and the levels of violent crime in children's neighbourhoods are associated with children's involvement in violence. Previous research suggests that ACEs are associated with involvement in violence, while PCEs are associated with decreased risk of involvement in crime and violence. There is some evidence that the relationship between ACEs, PCEs and involvement in violence is affected by the amount of violent crime in the local area.

This study explored whether these factors are associated with three violence outcomes, measured at ages 14 and 17: assault perpetration, the carrying or using of a weapon and gang involvement. It primarily used data on around 14,000 children from the Millennium Cohort Study (MCS), a study that is tracking a cohort of children born around the millennium. It also used police-recorded crime data to understand the amount of violent crime in the local area.

The ACEs examined by this study were: having a single parent; experiencing parental breakup; domestic violence; verbal abuse; physical abuse; parental alcohol abuse; parental drug use; parental mental health issues; poor parental relationships; poor parent-child relationship; and, having a parent with a long-term disability/illness. The list of PCEs included: having low-risk peers; positive peer experiences; good school connectedness; positive teacher-child relationships; participation in activities and hobbies; living in a safe neighbourhood; and feeling safe in the playground.

Key findings

A higher number of adverse childhood experiences (ACEs) is associated with an increased risk of children engaging in violence.	Having two or more ACEs compared to none increased the risk of assault perpetration by 19%, weapon involvement by 57% and gang involvement by 61%. Having six or more ACEs increased the risk of assault perpetration by 45%, weapon involvement by 150% and gang involvement by 154%. The combination of ACEs associated with the highest risk included parental drug use, single parenthood, domestic violence, physical abuse and long-term parental disability or illness.
A higher number of positive childhood experiences (PCEs) is associated with a decreased risk of children engaging in violence.	Having three to four PCEs compared to zero to two PCEs reduced the risk of assault perpetration by 12%, weapon involvement by 33% and gang involvement by 28%. Having six to seven PCEs reduced the risk of assault perpetration by 35%, weapon involvement by 66% and gang involvement by 59%. The combination of PCEs associated with the lowest risk included low-risk peers, good school connectedness, positive teacher-child relationship and positive peer experiences.
The link between ACEs and violence was reduced when children also had a high number of PCEs.	Having high numbers of PCEs partially offset the risks associated with ACEs. Children who had both a high number of ACEs and PCEs, compared to those with a high number of ACEs and low PCEs, had a lower risk of involvement in violence. For example, among children with three or more ACEs, the risk of assault

	perpetration fell by 22%, weapons involvement by 49% and gang involvement by 39% for those who also had five or more PCEs.
ACEs and PCEs better explain violence involvement than neighbourhood crime rates.	Children growing up in high-violence neighbourhoods were more vulnerable to involvement in violence. For example, the likelihood of weapons involvement was 62% higher for children growing up in the 20% most violent areas. However, neighbourhood crime levels were no longer associated with violence perpetration once characteristics, including ACEs and PCEs, were taken into account.
There is some evidence that differences in experiences of violence by ethnicity can be explained by family socioeconomic characteristics and exposure to ACEs and PCEs.	Black children had higher rates of assault perpetration (53.3% and 47.6%, respectively) than White children (41.7%). This difference in assault rates disappeared after controlling for socioeconomic family characteristics and ACEs and PCEs, suggesting much of the difference can be explained by differences in exposure to these family factors. However, this analysis was limited by a small sample size of children from individual ethnic minority groups and is, therefore, not as secure as some of the other findings.

Interpretation and implications

This study provides valuable information about the relationship between ACEs, PCEs, neighbourhood safety and children's involvement in violence. It is one of only a few studies to present evidence from an English or Welsh context. Insights from this study should be combined with findings from other research to identify and support the children who are most vulnerable to involvement in violence.

These findings should be interpreted carefully. Although the study looked at whether factors are associated with violence, it cannot confirm whether these factors caused violence. For example, children who experienced physical abuse were more likely to commit violence, but we can't rule out the possibility that this relationship is explained by another factor. Perhaps children who experienced abuse are also more likely to experience other hardships, which are the real drivers behind their involvement in violence. While this study used statistical techniques to try to rule out some other potential drivers, it was not able to capture all of these.

The strengths of this study included its use of a large nationally representative sample, the use of statistical methods that deal with missing data and maintain a representative sample and the fact that it found similar results across several additional analyses and robustness checks.

The results of the study should be considered alongside its limitations:

- Sexual abuse and the involvement of household members in crime are commonly described as ACEs but were not available in the MCS data set and were not examined in this study.
- The study relied on police-reported crime data to measure neighbourhood violent crime. However, much crime goes unreported to the police, especially in deprived areas. The findings on neighbourhood violence are less secure as a result.
- The analyses examining more serious types of violence in smaller subgroups of children, such as children from smaller ethnic groups, have smaller samples and are less precise.

Introduction

Context and literature review

Youth offending statistics (Youth Justice Board/Ministry of Justice, 2021) in England and Wales overall have shown a significant decrease in the last decade, with an especially large drop in offences classified as 'theft and handling stolen goods' and also other offences, such as 'criminal damage'. However, offences classified as 'violence against the person' remain high, with around 15,000 such offences being carried out in 2020 by young people aged 10 to 17 years. Moreover, knife and other weapon offences involving young people were nearly 50% higher in 2020 than five years previously. A better understanding of the risk and protective factors associated with these behaviours, using a contemporaneous cohort of young people, is a crucial first step in informing policymakers and practitioners on routes to prevention and intervention.

In this research, we focus on adverse childhood experiences (ACEs), positive childhood experiences (PCEs) and neighbourhood violent crime levels, as well as how these dimensions interact with each other in predicting youth violence. The family and home environment are undoubtedly one of the most important influences on the adjustment and development of children and young people, including the development of aggressive and violent behaviours (Derzon, 2010). While single adverse aspects of the family environment have been identified (Farrington, 2011), the study of ACEs focuses on the accumulation of multiple aspects of family dysfunction, which have been shown to be detrimental to various outcomes later in life (Appleton et al., 2017, Asmussen et al., 2020, Felitti et al., 1998, Houtepen et al., 2019, Straatmann et al., 2018, Astridge et al., 2023, Duke et al., 2010).

The ACEs framework developed by Felitti et al. (1998) has been especially influential, with a focus on 10 types of adverse experiences in the family environment: physical abuse, sexual abuse, psychological abuse, physical neglect, psychological neglect, witnessing domestic violence, having a close family member who misuses drugs or alcohol, having a close family member with mental health problems, having a close family member who served time in prison and parental separation or divorce. As highlighted by Asmussen et al. (2020), there might be additional ACE dimensions that should be considered. The effect of ACEs on individual outcomes, such as violence or other behaviours, is proposed to be driven by several interrelated biological, psychological and social mechanisms, which can affect brain development, stress responses and behavioural patterns (Anda et al., 2006, Danese and McEwen, 2012, Lupien et al., 2009, Shonkoff et al., 2012). Some have highlighted the idea of 'toxic stress' in childhood (due to the experience of a large number of multiple adversities), which prolongs the activation of the stress response system and leads to maladaptive and chronically dysregulated stress responses, affecting a broad

range of behaviours (Boivin and Hertzman, 2012, Harris, 2018, Nelson et al., 2020, Shonkoff et al., 2012).

At the other end of the spectrum, the concept of PCEs is concerned with resilience and the accumulation of familial factors, as well as factors across different domains of the child's life, that can protect against detrimental outcomes. Compared to ACEs, the PCE framework has been less well developed, with studies differing in the positive aspects included, although these generally involve experiences within the family as well as experiences external to the family, such as support from friends, participation in the community and organised activities, and connection to school (Baglivio and Wolff, 2021, Bethell et al., 2019).

Research has indicated that the presence of PCEs benefits multiple outcomes, including increased physical and mental health, school achievement, reduced teen pregnancy and youth offending (Bethell et al., 2019, Crandall et al., 2019, Crouch et al., 2021b, Hillis et al., 2010, Huang et al., 2023, Novak and Fagan, 2022, Sege and Harper Browne, 2017). Furthermore, evidence from both the field of mental health and criminology suggests that PCEs may be able to moderate or buffer the negative effect of ACEs (Baglivio and Wolff, 2021, Bethell et al., 2019, Craig et al., 2017, Kowalski et al., 2023, Novak and Fagan, 2022, Qu et al., 2022). PCEs are thought to operate through similar mechanisms to those of ACEs, but instead of undermining children's development, they support healthy social and emotional development, which promotes the development of competencies, self-regulation and social skills (Benard and Slade, 2009, Bronfenbrenner, 1979, Ladd, 2005, Masten, 2014).

Another potential influence on youth violence is the nature of the neighbourhood in which children grow up. The idea of neighbourhood effect gained popularity through the work of Wilson (1987), which was the catalyst for further work and the proposition of numerous theoretical mechanisms driving these effects (Van Ham et al., 2011), including social networks and social capital (Putnam, 2000, Sampson et al., 2002), institutional resources and public services (Jencks, 1990), economic opportunities and labour markets (Wilson, 1996), and cultural and psychological influences (Anderson, 2000). While there is a multitude of dimensions to the neighbourhood, the level of violent crime seems particularly relevant to youth violence. Some research has indicated that being exposed to violence as a victim or seeing someone else being victimised is associated with an increase in young people's likelihood of engaging in violence and carrying weapons (Centre for Crime and Justice Studies, 2009). However, understanding the causal role of the neighbourhood is immensely challenging, as neighbourhood characteristics tend to be highly correlated with individual and family characteristics, including ACEs and PCEs (i.e. selection bias; Van Ham et al., 2011), which may be the main causal drivers of outcomes such as youth violence. Others have suggested that neighbourhood risks may be associated differentially with youth

offending depending on exposure to ACEs and PCEs. A US study found that neighbourhood disadvantage was associated with an increase in serious crime offending in those young people who had a balanced mix of risk and protective factors or scored high on protective factors, while young people with a high risk score engaged in serious crime offences at a similar rate regardless of the level of deprivation in their neighbourhood (Wikström and Loeber, 2000). Although this was an unanticipated finding, study authors suggest that a possible interpretation might be that activities in adolescence increasingly take place in public settings, and this may mean that protective aspects of the family settings may be overpowered by the influence of a disadvantaged neighbourhood.

Previous studies have applied the ACE framework to the study of youth violence (Astridge et al., 2023, Baglivio and Epps, 2016, Bellis et al., 2014, Duke et al., 2010, Fagan and Novak, 2018, Fox et al., 2015), and some have examined PCEs (Baglivio and Wolff, 2021, Kowalski et al., 2023, Novak and Fagan, 2022), with existing studies being based on mostly retrospective rather than prospective data. There remains a major dearth of evidence in this area for the UK, with previous studies using predominantly US samples. There is also a lack of work examining young people's exposure to the level of violent crime in the neighbourhood and its association with youth violence. By linking area-based crime data to the MCS, the proposed research presents an opportunity to examine the role of area violence in combination with a wealth of other influential factors in the development of youth violence, using a large, nationally representative UK cohort study. It is also important to understand, specifically in a UK context, how levels of violent crime in the neighbourhood may potentially interact with ACEs and PCEs in relation to youth violence.

Additionally, it is important to understand whether ACEs, PCEs and neighbourhood crime affect groups of young people equally in terms of offending, especially across major social categories, such as gender and ethnicity. Some previous studies have suggested that males are more adversely influenced by ACEs than females (Leban, 2021, Leban and Gibson, 2020), while others have found that girls are more vulnerable (Pierce and Jones, 2022). The evidence for PCEs by gender has also been mixed, with some reporting stronger protective effects for females (Craig et al., 2017, Skodol et al., 2007) and others finding no difference (Gunay-Oge et al., 2020). Similarly, for neighbourhood effects, previous findings have produced mixed results (Airaksinen et al., 2021, Jacob, 2006, Karriker-Jaffe et al., 2009, Kling et al., 2005, Kroneman et al., 2004, Molnar et al., 2008). As for ethnicity, previous studies based on US data have indicated that ACEs have a stronger association with youth delinquency in minority ethnic groups than in White populations (Fagan and Novak, 2018, Jones et al., 2022), but a study from Germany found that neighbourhood effects are stronger in native than in immigrant groups (Oberwittler, 2013).

By identifying ACEs, the project may provide current information on some of the predictors of youth violence in England and Wales, which is a first step in informing early prevention strategies. Equally important, but far less frequently examined in previous studies, is the identification of PCEs, which highlight protective factors that can inform support strategies for young people. The potential of PCEs to reduce youth violence in the face of a high level of ACEs is an important aspect to examine, with results having the potential to make a significant impact on policy, practice and intervention. To date, no study has examined this using a UK sample. To what extent levels of violence matter for individuals' propensities for engagement in violent crime, over and above their family levels risks and protective factors, as well as interacting with these, can inform us on whether levers of intervention and prevention should be focused on the neighbourhood or elsewhere.

Providing answers to this study's research questions (RQs) can be of significant value to those tasked with reducing youth violence, as it could help inform where to best direct efforts and resources – ultimately leading to a reduction in youth violence. Findings could have enormous significance for the Violence Reduction Units (Home Office, 2020), which have been set up across the country to tackle the root causes of crime, and for preventative interventions aimed especially at adolescents.

Research aims

The overall aim of this research is to examine ACEs, PCEs and neighbourhood violent crime levels, as well as how these dimensions interact with each other in predicting youth violence.

Research questions

How do PCEs and ACEs relate to youth violence?
1. How do ACEs relate to youth violence?
    a. Which single and cumulative ACEs are associated with youth violence, and what are the magnitudes of the associations?
    b. Which specific combinations of single ACEs are most strongly associated with youth violence?
2. How do PCEs relate to youth violence?
    a. Which single and cumulative PCEs are associated with youth violence, and what are the magnitudes of the associations?
    b. Which specific combinations of single PCEs are most strongly associated with youth violence?
3. Do PCEs attenuate the association between ACEs and youth violence?

Is neighbourhood crime an important determinant of youth violence?

4. To what extent is neighbourhood violent crime using police.uk data a valid and reliable measure?
    a. To what extent is the measure of neighbourhood crime using police.uk data consistent with the measure of neighbourhood crime using the Index of Multiple Deprivation (IMD)?
    b. Does the police.uk violent crime measure show the same national trend over time (2011–2018) as the published Home Office statistics on crime in England and Wales?
5. Are rates of violent crime in one's neighbourhood associated with youth violence?

How do neighbourhood crime and childhood experiences (good and bad) interact?

6. Does the association between ACEs and youth violence differ for those in neighbourhoods with high versus low levels of violent crime?
7. Does the association between PCEs and youth violence differ for those in neighbourhoods with high versus low levels of violent crime?
8. Do PCEs attenuate the association between ACEs and youth violence more in low-crime areas or high-crime areas?
9. Do ACEs amplify the association between neighbourhood violent crime and youth violence?
10. Do PCEs attenuate the association between neighbourhood violent crime and youth violence?

Hypotheses

The context and literature section sets out the justification for the project, and our hypotheses are built around this. In summary, ACEs and neighbourhood levels of crime are considered risk factors for children's development and adjustment. Therefore, in this research project, we hypothesise that higher levels of these are associated with a higher risk of youth offending. In contrast, PCEs are considered protective factors, as these are thought to support positive development and adjustment in children and young people, and we, therefore, hypothesise that higher levels of PCEs are associated with a lower prevalence of youth violence.

- Q1: a) We expect single and cumulative ACEs to be associated with a higher likelihood of youth violence. b) We have no clear hypothesis as to which specific ACE combinations are most strongly related to youth violence.

- Q2: a) We expect single and cumulative PCEs to be associated with a lower likelihood of youth violence. b) We have no clear hypothesis as to which specific PCE combinations are most strongly related to youth violence.
- Q3: We hypothesise that a higher level of cumulative PCEs will attenuate the association between cumulative ACEs and youth violence.
- Q4: a) We expect Lower Layer Super Output Areas (LSOAs) to have a similar ranking in terms of the level of neighbourhood crime measured using police.uk data as in the IMD data. b) We expect the police.uk measure of neighbourhood crime to follow the same trend over time as the published Home Office national figures for crime.
- Q5: We hypothesise that a higher level of violent crime in the neighbourhood is associated with a higher likelihood of youth violence.
- Q6: As a high level of violence in the neighbourhood is a potential additional risk factor, we hypothesise that ACEs have a stronger association with youth violence in neighbourhoods with high levels of violent crime than in those with lower levels.
- Q7: We hypothesise that the association between PCEs and youth violence will be weaker in neighbourhoods with high levels of violent crime because neighbourhood violent crime is a potential risk factor and may undermine the protectiveness of PCEs for youth violence.
- Q8: Because neighbourhood violent crime is a potential risk factor, the extent to which PCEs reduce the association between ACEs and youth violence is hypothesised to be lower in areas with high levels of violent crime.
- Q9: Because ACEs are likely to be an additional risk factor, we hypothesise that neighbourhood violent crime will have a stronger association with youth violence for those with a high level of ACEs.
- Q10: Because PCEs are likely a protective factor, we hypothesise that neighbourhood violent crime will have a weaker association with youth violence for those with a high level of PCEs.

Key concepts

Youth violence
Three aspects of youth violence will be examined, each as a separate outcome. Information will be combined across ages 14 and 17 for each of the outcomes defined below. All three variables are self-reported by participants in the MCS.

1) Assault perpetration is defined as pushing, shoving, hitting, slapping or punching someone.

2) Weapon involvement is defined as carrying or using a weapon.

3) Gang involvement is defined as current or past membership of a street gang.

Adverse child experiences

These are experiences in childhood which are risk factors for adverse outcomes. The exact factors were explored and developed in the initial phase of the project, drawing heavily on previous research in the field, including studies that use the MCS. The focus of our ACEs is experiences within the family from age nine months to 11 years.

Positive childhood experiences

These are the experiences in childhood which protect against adverse outcomes. In our definition and measurement of PCEs, we drew on previous literature and explored their appropriateness for inclusion in the current project. The focus of our PCEs is on factors external to the family from age nine months to 11 years.

Neighbourhood violent crime

We focus on violent crimes and use police.uk-provided data from 2012 and 2013 (when participants were around age 11 to 13). Crime rates for violent offences were created by dividing the total number of violent crimes in each LSOA, which will define the neighbourhood, by the estimated resident population in the LSOA.

Ethics

Ethics approval was obtained for each of the survey sweeps through the National Health Service Research Ethics Committee system. Parents of participants up to age 14 provided written informed consent, and participants aged at least 16 provided verbal informed consent. For the secondary analyses carried out in the current study, ethical approval (REC 1759) was granted by the UCL IOE (Institute of Education) Research Ethics Committee.

Project team/stakeholders

The research team is based at the UCL Centre for Longitudinal Studies (CLS). Each team member is listed below with an outline of their responsibilities within this research project. None of the researchers have any conflicts of interest to declare.

- Dr Aase Villadsen is the Principal Investigator on this project and will carry out the data preparation and analyses and write up the main results. She will manage the project and liaise with the Youth Endowment Fund throughout the project.

- Dr Nicolas Libuy will carry out the crime data linkage and undertake some of the analyses relating to neighbourhood crime.
- Professor Emla Fitzsimons will be closely involved in the dissemination of findings, both written and oral, particularly among policymakers and the third sector.

Study design

Overview of research design

Table 2.0: Research design

Research design		A longitudinal observational design using secondary data from a UK birth cohort study
Data set(s) used		- Millennium Cohort Study (MCS) data - Police-recorded crime (police.uk) data - Home Office police-recorded crime (Home Office) data - Index of Multiple Deprivation data
Population of interest		Adolescents aged 14 to 17 born in England and Wales around the Millennium (2000–2002)
Size of the sample population		14,088 (imputed sample)
Stratification variable(s) (if applicable)		England and Wales
Outcomes	**Variable**	- Assault perpetration - Weapon involvement - Gang involvement
	Measure (instrument, scale, source)	- Assault perpetration at age 14 or 17, binary variable, MCS data - Weapon involvement at age 14 or 17, binary variable, MCS data - Gang involvement at age 14 or 17, binary variable, MCS data
Exposures	**Variable(s)**	- Adverse childhood experiences (ACES) - Positive childhood experiences (PCEs) - Neighbourhood violent crime
	Measure(s) (instrument, scale, source)	**ACES** Eleven single measures (binary variables) and a cumulative measure of the total number of ACEs (categorical variable), MCS data. **PCEs** Seven single measures (binary variables) and a cumulative measure of the total

		number of PCEs (categorical variable), MCS data. **Neighbourhood violent crime** A continuous measure of the per capita number of violent crimes reported to the police in each neighbourhood (Lower Layer Super Output Area) of participants in the MCS The category of crimes labelled 'violence and sexual offences' will be used, police.uk data.
The main method to be used or tested		Multivariate logistic regression

The study uses a longitudinal observational design using secondary data from the MCS, which is the youngest of the UK birth cohort studies to have reached adolescence. The MCS is especially suitable for addressing the proposed RQs, as it provides rich longitudinal data from a current sample of young people in the UK. This cohort was around age 17 when it was last surveyed in 2018, at which stage participants self-reported a range of offending behaviours – including violence – with similar information reported at age 14.

The initial MCS survey at nine months and follow-ups at regular intervals through childhood have measured a large range of aspects of participants' lives, with rich information available on their circumstances and experiences. This allows the study of how various types of adverse and positive aspects of childhood experiences (from birth to age 11) are associated with violence-related outcomes later in young people's lives at ages 14 and 17 (combined).

The population of interest is adolescents aged 14 to 17, as we examine youth violence during this period. As per the scope of the study brief, only those in England and Wales are included, which means the exclusion of Scotland and Northern Ireland. The total analytical sample size consists of 14,088 participants, which is achieved through multiple imputations, the details of which are provided further below. The measures of youth violence focused on in this study are assault perpetration, weapon involvement and gang involvement, which are the outcomes available in the MCS at age 14 and 17.

The exposures examined in relation to youth violence are a range of ACEs and PCEs and neighbourhood violent crime. The rationale for focusing on these is set out in the context and literature review further above. Details of the specific ACEs and PCEs and neighbourhood violent

crime and their measurement are provided further below. The analyses look at each of the single ACEs and PCEs and their cumulative number in relation to each of the three youth violence outcomes. As these outcomes are measured on a binary scale, they are examined using logistic regression.

To address the RQs pertaining to neighbourhood levels of violent crime, we will perform a novel linkage between MCS data and area-level police-recorded crime. Crime data have been collected by the police service in the UK monthly since 2011 and contain street-level data on crime incidents. The appropriateness of using police.uk data for the measurement of neighbourhood violent crime is investigated. This is done by examining the police.uk data source in relation to the neighbourhood crime domain of the IMD and by examining how consistent these data are with Home Office statistics, which is the reason for using these additional data sources listed in Table 2.0.

A timeline of the measures and data sources used is provided in Table 2.1.

Table 2.1: Timeline of measures and data sources used in the study

	Age 9 months	Age 3 years	Age 5 years	Age 7 years	Age 11 years	Age 14 years	Age 17 years
Youth violence outcomes (Millenium Cohort Study [MCS] data)							
Assault perpetration						🟨	🟨
Weapon involvement						🟨	🟨
Gang involvement						🟨	🟨
Adverse childhood experiences (MCS data)							
Single-parent status	🟥	🟥	🟥	🟥	🟥		
Parental breakup		🟥	🟥	🟥	🟥		
Domestic violence	🟥	🟥	🟥	🟥	🟥		
Verbal abuse		🟥	🟥	🟥			
Physical abuse		🟥	🟥	🟥			
Parental alcohol abuse	🟥	🟥			🟥		
Parental drugs use		🟥	🟥				
Poor parental mental health	🟥	🟥	🟥	🟥	🟥		
Poor parental relationship		🟥	🟥	🟥			
Poor mother–child relationship		🟥					
Maternal longstanding illness or disability	🟥		🟥	🟥	🟥		
Positive childhood experiences (MCS data)							
Good school connectedness				🟦	🟦		
Positive relationship to teacher					🟦		
Feeling safe in school playground				🟦			

Measure				
Low-risk peers			▮	
Positive peer experiences		▮	▮	
Participation in activities and hobbies			▮	
Living in a safe neighbourhood		▮	▮	
Neighbourhood violent crime (police.uk data)			▮	
Neighbourhood deprivation (Index of Multiple Deprivation data)			▮	
Covariates (gender, ethnicity, maternal age at birth, income, education and occupational status) (MCS data)	▮			

Data sources

Data from the UK MCS is our primary data set (see Table 2.2a). This includes a large sample of around 19,000 individuals born in the UK around the Millennium who were aged around 17 years at the most recent follow-up. We use data from all sweeps from age nine months to 17 years (2001–2018). We restrict the sample to those living in England and Wales.

In addition, we make use of police-provided crime data at the neighbourhood level (see Table 2.2b), which is linked to the MCS. We link police-recorded crime data obtained from police.uk (2012 and 2013), which covers 43 police forces in England and Wales. Data spanning the years 2011 to 2018 will be used to compare crime trends with published data from the Home Office.

Furthermore, the IMD in England (2010) and Wales (2011) (see Table 2.2c) is used. This is linked to the police.uk data and MCS data at the LSOA level.

Published open-source Home Office statistics on police-recorded violent crime at the police force level from 2011 to 2018 (see Table 2.2d) are used to run additional checks on the police.uk crime measures. This data is, however, not linked to the MCS.

Finally, data on ONS (Office for National Statistics) LSOA (Lower Super Output Area) mid-year population estimates are used and linked to derive crime rates per thousand population for each LSOA.

Table 2.2a: Data set description – Millennium Cohort Study

Name of data set	Millennium Cohort Study
Data owner(s)	University College London Centre for Longitudinal Studies
Type of data	Longitudinal birth cohort study

Population/geographic coverage or sampling frame	Individuals born in the UK in 2000–2002 sampled through the near-universal child benefit register
Years covered or survey waves	2001–2018 (seven waves in total), at age nine months and 3, 5, 7, 11, 14 and 17 years.
Exclusion criteria	Includes those living in England and Wales at the time last observed, thereby excluding those in Scotland and Northern Ireland
Expected population/sample size (following exclusion criteria)	Around 14,000 young people included in the final analytical sample
Documentation	**Sweeps 1–5 (age nine months to 11 years)** https://cls.ucl.ac.uk/wp-content/uploads/2017/07/MCS-Guide-to-the-Datasets-022014.pdf **Sweep 6 (age 14 years)** https://cls.ucl.ac.uk/wp-content/uploads/2018/10/mcs6_user_guide_28march2017.pdf **Sweep 7 (age 17 years)** https://cls.ucl.ac.uk/wp-content/uploads/2022/05/MCS7-user-guide-Age-17-ed2.pdf

Table 2.2b: Data set description – police-recorded crime (police.uk)

Name of data set	**Police Recorded Crime in England and Wales**
Data owner(s)	police.uk
Type of data	Administrative data of crimes reported to the police for each of the 43 territorial police forces in England and Wales, plus the British Transport Police
Population/geographic coverage or sampling frame	All crimes reported to the police in England and Wales at the neighbourhood/LSOA levels
Years covered or survey waves	Data covering the years 2011–2018.
Exclusion criteria	None

Expected population/sample size (following exclusion criteria)	Including all 43 police force areas in England and Wales and representing all 33,755 LSOAs in these two UK countries
Documentation	Information on this data and documentation: https://data.police.uk/about/

Table 2.2c: Data set description – Index of Multiple Deprivation

Name of data set	**Index of Multiple Deprivation (IMD) in England and Wales**
Data owner(s)	Gov.uk, Stats Wales
Type of data	National statistics geographical data
Population/geographic coverage or sampling frame	These data contain all LSOA areas in England and Wales. Each LSOA has an overall ranking across the total IMD and a ranking for each domain of the index. IMD domains in England: income, employment, health and disability, education skills and training, barriers to housing and services, living environment and crime IMD domains in Wales: income, employment, health, education, housing, environment, access to services and community safety
Years covered or survey waves	IMDs are constructed with some year intervals. We use the 2010 English version and the 2011 Welsh version, as these are most consistent with the police.uk data covering the years 2012–2013 with which we want to compare.
Exclusion criteria	None
Expected population/sample size (following exclusion criteria)	All 33,755 LSOAs across England and Wales

Documentation	Information on this data and documentation
	England:
	https://www.gov.uk/government/statistics/english-indices-of-deprivation-2010
	Wales:
	https://statswales.gov.wales/Catalogue/Community-Safety-and-Social-Inclusion/Welsh-Index-of-Multiple-Deprivation/Archive/WIMD-2011

Table 2.2d: Data set description – police-recorded crime (Home Office)

Name of data set	Police Recorded Crime in England and Wales
Data owner(s)	Home Office
Type of data	Administrative data of crimes reported to the police for most of the 43 territorial police forces in England and Wales, plus the British Transport Police
Population/geographic coverage or sampling frame	All crimes reported to the police in England and Wales at the neighbourhood/LSOA levels, with the exception of some police forces that do not submit their figures, including Greater Manchester Police, West Midlands Police and a number of other forces
Years covered or survey waves	We use data covering 2011–2018, as this is the period over which we wish to compare trends in violent crime with police.uk data.
Exclusion criteria	None
Expected population/sample size (following exclusion criteria)	Including most police force areas in England and Wales, with exclusions as noted above.

Documentation	Data user guide: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/560132/pprc-user-guide-oct16.pdf General website: https://www.gov.uk/government/statistics/police-recorded-crime-open-data-tables#full-publication-update-history

Linking data sets

Linking police-recorded crime data from police.uk to IMD data

We link IMD data (2010 English IMD, 2011 Welsh IMD) and police.uk data at the LSOA level (2011) to explore the extent to which the measure of neighbourhood crime using police.uk data aligns with the measure of neighbourhood crime based on the IMD. For England, 2010 police.uk data was unavailable, so we compared the IMD crime measure with the 2011 annual crime rate, which is the closest available year in the police.uk data.

Linking police-recorded crime data from police.uk and IMD data to MCS

LSOA-level data from police.uk were linked with IMD data and then linked to the MCS using the LSOA of MCS participants' residences. The LSOAs where participants lived at each MCS sweep were derived by the CLS using the residential postcode of MCS participants. This information was accessed after an application to the CLS Data Access Committee. The LSOA identifiers in MCS are available for all productive surveys, which allowed us to link police.uk data for 100% of MCS participants in England and Wales.

Linking ONS LSOA population estimates to MCS

We linked ONS annual LSOA population estimates to MCS data using the LSOA of MCS participants' residences. Population estimates at the LSOA level are used as the denominator for crime rates. We link population estimates for 2012, as this corresponds to the period when neighbourhood violent crime was measured.

Linkage method

As shown in Figure 2.0, the linkage between police data and MCS will be one to many (1:m) because IMD data and police.uk are aggerated at the LSOA level using a unique LSOA identifier, and there are multiple MCS participants per LSOA.

Figure 2.0: The linkage between police and MCS data

Data protection

All researchers at UCL have undergone training in handling and processing confidential data. They complete the NHS Digital's Data Security Awareness course annually. Although all data in the MCS remain fully anonymised, once data have been linked to additional sources, they are deemed especially sensitive. All such analyses are therefore carried out via the UCL Data Safe Haven (DSH), which conforms with NHS Digital's Information Governance. Data will be retained in the DSH for 10 years after the publication of results in line with the UCL research data policy. After this, it will be securely deleted from the DSH using the Cipher Security Tool.

Researchers have adhered to the end-user agreement of the UK Data Service (UK Data Service, 2023). This involves a range of conditions; one of them is to preserve the confidentiality of, and not attempt to identify, individuals, households or organisations in the data. Due to the large sample size of the MCS, it is unlikely that any analyses will produce small cell numbers; however, we adopt the rule of thumb to not report any results with table cell counts of 10 or less.

The processing and analysis of these data is fully within the UK GDPR framework (Article 6) on the basis that MCS participants have given their consent for their data to be used for research purposes, including linkage with other data. An additional legal basis is that research is a public task, and data processing is necessary for us to perform this task. This includes the analyses of special categories of data, which in this project include gender and ethnicity.

Variables and measurement

Outcomes measures

Three aspects of youth violence are examined as separate outcomes. Self-reported information is combined across ages 14 and 17 for each of the outcomes, meaning that these behaviours could have been at either age 14 or 17. Aggregating outcomes across the two time points was necessary, as the prevalence of weapon involvement and gang involvement would have been too low to examine sensibly (lack of statistical power) for each time point.

1) *Assault perpetration* is defined as pushing, shoving, hitting, slapping or punching someone.
2) *Weapon involvement* is defined as carrying or using a weapon.
3) *Gang involvement* is defined as current or past membership of a street gang.

Table 2.3 details the questions participants were asked at ages 14 and 17. Note that weapon involvement combines carrying or using a weapon, which is asked as two separate questions, but these are combined because the prevalence of using a weapon is very low, which prevents it from being examined as a single outcome.

Table 2.3: Youth violence questionnaire measures at ages 14 and 17

	Age 14	Age 17
Assault perpetration	In the last 12 months, have you pushed or shoved**/**hit/slapped/punched someone? [1] *Response options: (yes, no)*	In the last 12 months, have you pushed or shoved**/**hit/slapped/punched someone? [1] *Response options: (yes, no)*
Carrying a weapon	Have you ever carried a knife or other weapon for your own protection because someone else asked you to or in case you get into a fight? [1] *Response options: (yes, no)*	In the last 12 months, have you carried a knife or other weapon for your own protection, because someone else asked you to or in case you got into a fight? [2] *Response options: (yes, no)*
Using a weapon	In the last 12 months, have you used or hit someone with a weapon? [1] *Response options: (yes, no)*	In the last 12 months, have you hit someone with or used a weapon? [1] *Response options: (yes, no)*
Gang membership	Are you a member of a street gang? (By a street gang, we mean groups of young people who hang around together and have a specific area or territory; have a name, colour or something else to identify the group;	Are you a member of a street gang? (A street gang is a group of young people who hang around together and have a specific area or territory; have a name, colour or something else to identify the group; possibly have rules or

	possibly have rules or a leader; and may commit crimes together.)[1]	a leader; and may commit crimes together.)[2]
	Response options: 1. yes, 2. no, 3. I used to be a member but am not any more	*Response options: 1. yes, 2. no, 3. I used to be a member but am not any more*

Notes
[1] Self-completion questionnaire completed during an interview visit
[2] Online questionnaire (CAWI) completed during or after an interview visit

Exposure measures

Adverse childhood experiences

These are experiences in childhood which are thought to be risk factors for adverse outcomes. The original ACEs involve 10 experiences that focus on the family environment: physical abuse, sexual abuse, psychological abuse, physical neglect, psychological neglect, witnessing domestic violence, having a close family member who misuses drugs or alcohol, having a close family member with mental health problems, having a close family member who served time in prison and parental separation or divorce (Felitti et al., 1998).

In terms of how we measure ACEs in the current study, we considered the original framework and variables used in previous ACE research using the MCS sample, which include the following dimensions: 1) verbal maltreatment, 2) physical maltreatment, 3) parental divorce, 4) parental mental illness, 5) parental alcohol use, 6) parental drug use and 7) domestic violence (Jackson et al., 2022, Straatmann et al., 2018). However, as recommended in a recent report on ACEs (Asmussen et al., 2020), we explored the option of including further family adversities using the rich set of variables available in the MCS, and we cover a longer period in childhood (age nine months to 11 years) than in previous studies using the MCS, which have tended to focus just on early childhood. We focus on additional family factors, as we keep this separate from PCEs (which are all outside the family), and neighbourhood crime, which we examine in interactions with ACEs. An alternative approach would have been to combine all of these into a larger ACE framework by adding up adverse factors within the family with those external to the family. But this would have prevented us from looking at the buffering effect of PCEs. Our approach of extending the timeframe for ACEs is more in line with the original ACE framework, which considers experiences in the first 18 years of life. We limit our ACE measures to ages nine months to 11 years because the youth violence outcomes examined are measured for the first time at age 14, the first survey sweep after the age 11 sweep. The ACE exposures had to be measured before the outcomes to reduce the risk of reverse causation.

The full range of ACEs we explored is shown in the Appendix (see Table A2.0.1). It is noteworthy that ACEs are reported by parents in this study and prospectively to self-reported adolescent violence. This has the advantage of reducing method bias, referring to the inflation of the association between two variables as a result of measures originating from the same reporters. We adopted the rule that for an item to be included in the final ACE cumulative measure, it had to have a statistically significant bivariate association with one of the three violence outcomes, which was tested in unadjusted regression models. Adopting this rule was especially important for variables that were not part of the original ACE framework but were explored as potential new ACEs. We wanted to ensure that we were including genuine risks in the larger framework. The results of these examinations are shown in Table A2.0.2 (see Appendix).

Candidate variables that were dropped were poor mother–child attachment, poor father–child relationship, paternal disability and being a young carer. It should be noted that these are all 'exploratory' factors not included in previous ACE research and that the attachment measure had poor interitem reliability. The final ACEs consist of 11 single items measuring adversity during early to late childhood: having a single parent, parental breakup, domestic violence, verbal abuse, physical abuse, parental alcohol abuse, parental drug use, poor parental mental health, poor parental relationship, poor mother–child relationship and longstanding maternal disability/illness. These are shown in Table 2.4, which also shows who the reporters are and the age at which the information was collected. Note that some ACEs were measured more consistently across the sweeps; for example, single parent status was measured in all sweeps, whereas the mother–child relationship was measured only once at age 3, and this is likely to affect how prevalent these exposures are. The exact measures and instruments used to measure each of the ACEs are detailed in Box 2.0.

The numbers of different types of adverse experiences were summed as a continuous measure. Only a very small proportion experienced a very high number of ACEs (see the descriptive statistics in the results section), so to ensure sufficient power in further analyses, those with six or more ACEs were combined into a single category. This summary approach is consistent with that used in research by those developing the ACE framework (Anda et al., 2006). In some analyses, the ACE measure was aggregated further, distinguishing between those with low (0-2) versus high (3 or more) ACEs. These thresholds were set using the mean number of ACEs (2.08). This binary measure was used when ACEs were examined in combination with other exposures (PCEs or neighbourhood violent crime), or to enable subgroup analyses for multiple ethnic groups.

In analyses that examine which specific combinations of ACEs have the strongest association with youth violence outcomes, ACE measures are combined in various 5-item combinations of the 11 originalitems, giving 399 possible ACE combinations.

Table 2.4: Overview of included adverse childhood experiences – reporters and measurement time points

	Reporter	Age 9 months	Age 3 years	Age 5 years	Age 7 years	Age 11 years
Single parent status	Main parent	x	x	x	x	x
Parental breakup	Main parent		x	x	x	x
Domestic violence	Main parent	x	x	x	x	x
	Partner	x	x	x	x	x
Verbal abuse	Interviewer		x			
	Main parent			x	x	
Physical abuse	Interviewer		x			
	Main parent			x	x	
Parental alcohol abuse	Main parent	x	x			x
	Partner	x	x			x
Parental drug use	Main parent		x	x		
	Partner		x	x		
Poor parental mental health	Main parent	x	x	x	x	x
	Partner		x	x	x	x
Poor parental relationship	Main parent	x	x	x		
	Partner	x	x	x		
Poor mother–child relationship	Main parent		x			
Longstanding maternal illness or disability	Main parent	x		x	x	x

Box 2.0: Measurement of the final adverse childhood experiences included in the study

Some types of ACEs were measured multiple times throughout childhood, e.g. single parent status and domestic violence were captured in all sweeps; however, these were counted as one ACE regardless of whether they were experienced in one or more sweeps. Therefore, the cumulative ACE tallies up the total number of *different* types of adverse experiences during the early to late childhood period. We acknowledge that the fact that some exposures are measured more than others is a limitation, even though we only count each type of risk once. We wanted to capture risks throughout childhood rather than limit them to one specific sweep. We used the exploratory analyses in Table A2.0.2 (see Appendix) to guide which measures and reporters' information to include in the final ACE measure.

Single parent status. This was reported by the main parent in all sweeps, from age nine months to 11 years, by completion of the household grid that listed people living in the household and their relationship

to the main parent. From this information, a variable was derived for each sweep based on whether there were one or two parents/carers in the household. A single parent was defined as not living with a spouse or partner.

Parental break-up. Using the household grid on which the main parent reported household members and their relationships to the main parent, it was worked out whether a spouse or partner who was reported in the previous sweep had left the household in the subsequent sweep. Because household members have individual ID numbers, a new partner could be distinguished from a previous partner. The break-ups of biological as well as stepparents were included. Because parental break-up was measured between all sweeps, this measure was available in all sweeps, except at age nine months.

Domestic violence. For those with a spouse or partner in the household, the main parent and their partner were asked whether the other had ever used force on them, such as grabbing, pushing, shaking, hitting or kicking. This was asked in all five childhood sweeps (age 9 months to 11 years). Those who responded 'yes' or 'don't want to answer' were identified as having experienced domestic violence. The same approach was taken in a previous study using the MCS (Straatmann et al., 2018). The measure used in this study was whether *either* parent had ever experienced domestic violence. The inclusion of both parents was based on our exploratory analyses that showed that both violence against the main parent and the partner were associated with youth violence.

Verbal abuse. This was reported by the interviewer at age 3 based on their observation of the parent and child. They reported whether the parent scolded (shouted) or made derogatory comments to the child more than once during the visit. At ages 5 and 7, the main parent reported how often they shouted at the child when he/she was naughty. 'Daily' shouting at the child was defined as verbal abuse versus no verbal abuse (never, rarely, sometimes, often). The threshold was set fairly high and included frequent use (daily) of scolding to reflect 'abuse'. The main parent also reported shouting at age 3; however, this had a very weak association with youth violence compared to the interviewer report, which was therefore used instead.

Physical abuse. The interviewer reported on behalf of the child at age 3 whether the main parent had slapped or spanked the child during the visit. At ages 5 and 7, the main parent reported how often they would smack the child when he/she was naughty. 'Daily' or 'often' were classified as physical abuse, whereas 'never', rarely and 'sometimes' were regarded as no physical abuse. The threshold was set fairly high and included only frequent use (daily or often) of slapping and spanking to reflect 'abuse'. The main parent also reported smacking at age 3; however, this had a very weak association with youth violence compared to the interviewer report, which was therefore used instead.

Parental alcohol abuse. At 9 months, both the main parents and any partner reported alcohol frequency and volume. For females, alcohol abuse was defined as drinking three to four times a week or more often and consuming 15 or more drinks weekly. For males, alcohol abuse was defined as drinking three to four times a week or more often and consuming 25 or more drinks weekly.

At age 3 years, the CAGE alcohol questionnaire was administered to main parents and partners (Ewing, 1984). This questionnaire has four items: have you ever felt you should cut down on your drinking? Have people annoyed you by criticising your drinking? Have you ever felt bad or guilty about your drinking?

Have you ever had a drink first thing in the morning to steady your nerves or to get rid of a hangover (eye-opener)? Responding yes to two or more of these questions is indicative of alcohol abuse.

At age 11 years, main parents and partners reported on the five-item AUDIT scale (Kim et al., 2013): how often do you have a drink that contains alcohol? How many standard alcoholic drinks do you have on a typical day when you are drinking? How often in the last year have you found you were not able to stop drinking once you had started? How often in the last year have you failed to do what was expected of you because of drinking? Has a relative, friend, doctor or health worker been concerned about your drinking or advised you to cut down? The scale ranges from 0 to 20, and scores of 7 or above are indicative of alcohol abuse.

Alcohol abuse by either parent at any of the three time points was defined as the participant having experienced this type of ACE, as our initial analyses showed an association between youth violence and alcohol abuse for both the main parent and the partner.

Parental drug use. At ages 3 and 5, main parents and partners were asked, 'During the past year, have you used any recreational drugs like cannabis, cocaine or ecstasy?' Responding 'regularly' or 'occasionally' was defined as drug use, whereas 'never' was classified as no drug use. Drug use by either parent, at either time point, was classified as an ACE as indicated by the significant association with youth violence in the exploratory analyses.

Poor parental mental health. At 9 months, maternal mental health was assessed using the nine-item Malaise, with binary yes/no responses and scores ranging from 0 to 9, with 4 or above considered in the clinical range (Rutter et al., 1970).

> Do you feel tired most of the time?
> Do you often feel miserable or depressed?
> Do you often get worried about things?
> Do you often get into a violent rage?
> Do you often suddenly become scared for no good reason?
> Are you easily upset or irritated?
> Are you constantly keyed up and jittery?
> Does every little thing get on your nerves and wear you out?
> Does your heart often race like mad?

At ages 3, 5, 7 and 11, parental mental health was measured for the main parents and partners. This was measured using the Kessler (K6), a six-item measure ranging from 0 to 24, with scores of 13 and above considered in the clinical range (Kessler et al., 2003).

> *(Responses: all of the time, most of the time, some of the time, a little of the time, none of the time)*
> During the last 30 days, about how often did you feel so depressed that nothing could cheer you up?
> During the last 30 days, about how often did you feel hopeless?
> During the last 30 days, about how often did you feel restless or fidgety?

During the last 30 days, about how often did you feel that everything was an effort?
During the last 30 days, about how often did you feel worthless?
During the last 30 days, about how often did you feel nervous?

This ACE was identified if either parent had ever scored in the clinical range on these measures.

Poor parental relationship. At ages 9 months, 3 years and 5 years, a five-item shortened version of the Glombok-Rust Inventory of Marital State (Rust et al., 1986) was administered to the main parents and partners: 'My partner is usually sensitive to and aware of my needs', 'My partner doesn't seem to listen to me', 'I sometimes feel lonely even when I am with my partner', 'I wish there was more warmth and affection between us', 'I suspect we may be on the brink of separation' (strongly agree, agree, neither agree nor disagree, disagree, strongly disagree). The measure ranged from 0 to 20. Scores from both parents at each respective age were then combined, and those with the 10% lowest scores were classified as having a poor parental relationship. This ACE was identified if, at any time point, parents reported a poor relationship. Another measure capturing parental unhappiness was also examined but showed no association with youth violence outcomes.

Poor mother–child relationship. The Pianta Child-Parent Relationship Scale (Driscoll and Pianta, 1992) was administered to the main parent at age 3. This is a 15-item scale, with eight items assessing closeness (e.g. 'I share an affectionate, warm relationship with my child', 'It is easy to be in tune with what my child is feeling') and seven items assessing conflict between the parent and the child (e.g. 'My child and I always seem to be struggling with each other', 'My child easily becomes angry at me'). This measure uses a five-point scale: definitely does not apply, not really, neutral/not sure, applies sometimes, definitely applies). The measure generates a total scale score reflecting an overall positive relationship. A poor mother–child relationship was defined as scoring in the bottom 10% of the scale, as we wanted to identify those with a severely impaired mother–child relationship and, therefore, those most at risk. We use the term mother–child relationship as, in 98% of cases, the main carer was the mother. The measure was also administered to fathers/partners; however, there was no significant association with any of the youth violence outcomes, so only the maternal measure was included.

Longstanding maternal illness or disability. At ages 9 months and 5, 7 and 11 years, the main parent reported whether they had a longstanding illness, disability or infirmity and, in a separate question, whether this limited their activities in any way. A positive response to both questions was classed as having a longstanding illness or disability. Partner reports were also available; however, these had no association with any youth violence outcomes and were therefore not included.

Positive childhood experiences

These are the experiences in childhood which are thought to protect against adverse outcomes. The PCE framework is less well defined, but it is generally agreed that it includes the family–child relationship and communication, feeling supported by family, feeling supported by friends, participating in community and organised activities, and feeling connected with school (Baglivio and Wolff, 2021, Bethell et al., 2019). The emphasis of PCEs is, therefore, on positive experiences across various life domains. In the current study, we focus solely on factors outside the family

environment because one of our RQs is how PCEs may attenuate the detrimental effects of ACEs that are centred around family experiences. In this way, we make a clear separation between adverse experiences within the family and positive extrafamilial experiences.

In our definition and measurement of PCEs, we draw on previous literature and include aspects used in previous studies which are available in the MCS data set. Like our approach to ACEs, we also consider additional protective factors as a way of further developing and contributing to the existing PCE framework. The PCEs considered are experiences in early to late childhood (age 3 to age 11 years, as there were no measures at age 9 months) in order to mitigate reverse causation with youth violence outcomes measured first at age 14.

The PCEs that were explored and considered for inclusion are shown in Table A2.0.3 (see Appendix). Candidate variables were dropped if they lacked bivariate association with any of the three violence outcomes. These associations were tested in unadjusted regression models (see Appendix, Table A2.0.4). The following PCEs were dropped for this reason: whether the child is in formal childcare, how frequently they see their grandparents and whether they attend afterschool clubs. The final PCEs include seven items that measure positive experiences during early to late childhood: good school connectedness, positive teacher–child relationships, feeling safe in the playground, low-risk peers, positive peer experiences, participation in activities and hobbies, and living in a safe neighbourhood. Table 2.5 shows each of the included PCEs and the time points at which they were measured, as well as the reporter, which is largely the participants themselves. Note that most PCEs were just measured once during childhood, and the majority were measured at ages 7 and 11. The exact measures and instruments used to measure each of the PCEs are detailed in Box 2.1.

The numbers of single positive experiences were summed as a continuous measure, and to ensure sufficient power in the further analyses, these were then categorised by combining respondents with two or fewer and six or more, as only a very small proportion experienced a very low or very high number of PCEs (see the descriptive statistics in the results section). In some analyses, the PCE measure was reduced further by distinguishing between low (0–4) and high (5 or more) PCEs. These thresholds were set using the mean value of PCEs (3.80). This binary measure was used when PCEs were examined in combination with other exposures (ACEs or neighbourhood violent crime) or to enable subgroup analyses for multiple ethnic groups.

In analyses that examine the specific combinations of PCEs that have the strongest association with youth violence outcomes, the PCE measures are reduced to include only four items (different combinations of the full seven items). This results in 35 possible PCE combinations.

Table 2.5: Overview of included positive childhood experiences – reporters and measurement time points

	Reporter	Age 9 months	Age 3 years	Age 5 years	Age 7 years	Age 11 years
Good school connectedness	Participant				x	x
Positive relationship with their class teacher	Participant					x
Feeling safe in the school playground	Participant				x	
Low-risk peers	Participant					x
Positive peer experiences	Participant				x	x
Participation in activities and hobbies	Participant					x
Living in a safe neighbourhood	Main parent		x	x		
	Participant					x

Box 2.1: Measurement of the final positive childhood experiences included in the study

Some types of PCEs were measured at multiple times points throughout childhood; however, these were counted as one PCE regardless of whether they were experienced in one or more sweeps. Therefore, the cumulative PCEs count the total number of different types of positive experiences during the early to late childhood period. We used the exploratory analyses in Table A2.0.5 (see Appendix) to guide which measures to include in the final PCE measure.

Good school connectedness. Both at ages 7 and 11 years, participants were asked about their school experiences in six items. Five of the items were the same at both ages, and one was slightly different, as indicated in brackets in the following. How much do you like school? How often do you try to do your best at school? How often is school interesting? How often do you feel unhappy at school? How often do you get tired at school? How often do you get fed up at school? (age 7) How often do you feel school is a waste of time? (age 11). The scoring range at age 7 was 0 to 12, and at age 11, it was 0 to 18, with higher scores indicating a higher level of school connectedness. Good school connectedness was identified as scoring in the highest 40% of scores at both ages.

Positive relationship with teacher. At age 11, respondents reported on their relationship with their teacher. How much do you like your class teacher (a lot, a bit, not at all)? How often do you think your class teacher is getting at you (all of the time, most of the time, some of the time, never)? A positive teacher–child relationship was defined as liking the teacher a lot and never feeling that the teacher was getting at them.

Feeling safe in the school playground. At age 7, participants responded to the question: How often do you feel safe in the playground? This PCE was identified if the response was 'all of the time' as opposed to 'never' and 'some of the time'.

Low-risk peers. At age 11, participants reported on their peers' smoking and drinking behaviours in two questions: how many of your friends smoke cigarettes? How many of your friends drink alcohol? (None of them, some of them, most of them, all of them.) Having low-risk peers was defined as not having any peers who drink or smoke.

Positive peer experiences. At ages 7 and 11, participants were asked about their experiences with peers. How often do you feel left out of things by other children? How often do other children bully you? (All of the time, some of the time, never.) Positive experiences were defined at age 7 as reporting being bullied or left out 'never' or 'some of the time' versus 'all of the time'. At age 11, the questions were: how often do other children hurt you or pick on you on purpose (most days, about once a week, about once a month, every few months, less often, never)? How often do you argue or fall out with your friends (most days, at least once a week, at least once a month, less often than once a month, never)? Positive peer experiences were defined at age 11 as being hurt or picked on and arguing with friends 'never' or 'less often than once a month'. This PCE was defined as having positive peer experiences at both ages.

Participation in activities and hobbies. At age 11, participants were asked how often they engage in arts and crafts, reading, and sports/exercise: how often do you draw, paint or make things, not at school? How often do you read for enjoyment, not for school? (Most days, at least once a week, at least once a month, less often than once a month, never.) How often do you play sports or active games inside or outside, not at school (five or more days a week, four days a week, three days a week, two days a week, one day a week, less often than once a week, not at all)? This PCE was identified if participants engaged in all three activities at least once a week.

Living in a safe neighbourhood. Main parents were asked at ages 3 and 5 about how safe they felt the areas they lived in were (very safe, fairly safe, neither safe nor unsafe, fairly unsafe, very unsafe). At age 11, participants themselves were asked a similar question: how safe is it to walk, play or hang out in this area during the day (very safe, safe, not very safe, not at all safe)? This PCE was defined as living in a 'safe', 'very safe' or 'fairly safe' area at all three time points. It would have been an option to use linked IMD on community safety, which arguably would have been a more objective measure than parent reports. However, if we had used IMD crime/community safety, this would have been at the LSOA level. The safe neighbourhood measure reported by parents is likely to capture the more immediate neighbourhood rather than the much larger LSOA area.

Neighbourhood crime

Neighbourhood violent crime was measured using police.uk data, which holds data on all offences reported to the police in 43 police forces in England and Wales, with offences categorised into types. The category 'violence and sexual' offences was the closest category to our measure of neighbourhood violent crime and was therefore used in this study. It includes offences such as death or serious injury, homicide, sexual offences, stalking and harassment, and violence with/without injury, among others. Using data covering the years 2012 and 2013, the total numbers of this type of offence were counted for each LSOA of participants in the MCS and divided by the resident population estimate in the same area (using the 2012 population estimate). This creates a continuous measure of the number of violent crimes per thousand residents. A secondary measure of general neighbourhood crime was created using the same methodology. This secondary measure included the following crime types: violence and sexual offences, burglary, theft, and criminal damage. This creates a continuous measure of the number of general crimes per thousand residents.

In the analyses, the measures of neighbourhood crime were transformed into categorical variables. These included quintiles (lowest 20%, lowest 20–40%, middle 40–60%, highest 60–80%, highest 80–100%), and in some analyses in which neighbourhood violent crime was examined for subgroups (gender and ethnicity) or in combination with the exposure measures ACEs and PCEs, tertile measures were used (low <33%, medium 33–66%, and high >66%) order to reduce the number of interacting variables and for reasons of statistical power and model convergence.

Other measures

A number of other measures were used in the study, mainly as covariates and for subgroup analyses.

Gender. Each participant's sex at birth was reported by the main parent.

Ethnicity. Each participant's ethnicity was reported by the main parent in the initial survey sweep. The categorisations use the five categories recommended by the Office for National Statistics: Asian, Black, Mixed, White and Other (Office for National Statistics, 2023).

Maternal age in years at the participant's birth. This is derived from the date of birth of the mother and the date of birth of the participant, both of which were reported by the main parent.

Household education. This was reported by the main parent and the partner in the initial survey sweep. It measures the highest educational level in the household using the National Vocational

Qualifications (NVQ) system, ranging from NVQ1 (no qualifications) to NVQ5 (postgraduate degree).

Household occupational status. This is reported by the main parent and the partner, who provide a range of information about their occupations and employment statuses, including whether they are an employer, self-employed or employee, their organisation size and their supervisory role. It classifies respondents using the National Statistics Socio-Economic Classification (Rose and Pevalin, 2003), which has five categories: 1. Managerial and Professional, 2. Intermediate, 3. Small employers and self-employed, 4. Low supervisory and technical and 5. Semi-routine and routine. The highest occupational status (in the current or most recent job) in the household (main parent or partner) is used in this study. The small number of families where neither parent had ever been employed were initially treated as missing, but then values were imputed using multiple imputation, which is outlined further below.

Household income. Household income in childhood (ages 9 months to 11 years) was reported by the main parent or caregiver at each of the sweeps in early to late childhood (ages 9 months and 3, 5, 7 and 11 years). Banded responses were used to impute continuous income, which was equivalised to consider household size and composition (CLS, 2020). Weekly income (average across the five sweeps) in units of £100 was used in this study.

Single parent in number of sweeps. This captures the number of survey sweeps during childhood from age 9 months to 11 years in which participants lived with a single parent, ranging from 0 to 5 sweeps.

Country. This is the UK country of residence in the initial sweep, including just England and Wales.

Neighbourhood deprivation. These are four non-crime dimensions of the IMD which are common to both the 2010 English and the 2011 Welsh IMDs: income deprivation, employment deprivation, health deprivation, and education skills and training deprivation. These measures capture cohort members' exposures to deprivation at either age 10 or 11. IMD domains are ranks created within each country respectively (England and Wales). The domains were standardized (z-scored) within each country and then added together to combine each of the IMD domains for England and Wales. Then, each of the four combined domains was standardized. Although these domains are not measured in the exact same way in the English and Welsh IMD, and their rankings are within each country rather than across England and Wales as a whole, we use this approach of combining these IMD measures to run combined analyses for England and Wales. Further justification for combining these is that neighbourhoods with a low ranking in one country are likely to be approximately equivalent to a low ranking neighbourhood in the other

country when transformed into standardised z-scores, and these measures are used solely as additional control variables in robustness checks rather than our primary exposure measures.

Sample size

The total sample size (imputed sample, see multiple imputations section further below) includes 14,088 participants born in England and Wales around the Millennium (2000–2002).

Research methodology

Descriptive analysis

A range of descriptive analyses are carried out. Descriptives of the overall sample are provided, reporting percentage frequencies of the sample by demographic and socioeconomic variables (country, gender, ethnicity, household education, household occupational status, household income, maternal age and single parent status). Then descriptives of the three youth outcomes are reported by overall prevalence, as well as by demographic and socioeconomic characteristics. Finally, descriptive analyses of the exposure measures ACEs, PCEs and neighbourhood crime are carried out. These provide the prevalence of each ACE and PCE and the frequencies of the cumulative measures of the total number of ACEs and PCEs. Further descriptives of the cumulative ACEs and PCEs by demographic and socioeconomic characteristics are provided. The association between ACEs and PCEs are also presented, including correlations between single ACEs and PCEs. Similarly, neighbourhood crime variables (our primary measure of violent crime and the secondary measure of general crime) are described, including their associations with ACEs and PCEs. Confidence intervals (95%) are reported for all descriptive analyses. All descriptive analyses use weights that adjust for the complex sampling design in the initial survey of the MCS.

Inferential analysis

Multivariate logistic regression is the main analytical approach for examining the association between exposure variables and youth violence (assault perpetration, weapon involvement, gang involvement) at ages 14 and 17 due to these outcomes being binary. In all models, a range of covariates are included to reduce omitted variable bias: gender, ethnicity, maternal age at birth, income, education and occupational status. These are regarded as some of the core confounders between childhood experiences and child outcomes. Also included is a variable that measures the number of sweeps in which the main parent was single, which was included because the measurement of ACEs varies by whether there were one or two parents in the household. A clear advantage of multivariate regression for addressing our RQ over other

techniques, such as Multilevel Modelling methods (also referred to as Random Effects models), is that it allows us to lessen potential omitted variable biases by controlling for area-level fixed effects, e.g., police force fixed effects, while also allowing the fixed effects to be correlated with the error term. Additionally, the scattered geographical distribution of MCS participants is not conducive to modelling hierarchical data structures using Multilevel Modelling.

For ease of interpretation, the results of the logistic regressions (obtained using the logit link function) are reported as marginal effects, which provide the percentage or prevalence of adolescents who engage in youth violence by the number of ACEs and PCEs while adjusting for confounding factors. Also, risk ratios are provided (obtained from Poisson log-linear models), which report the ratio of youth violence prevalence in the group with the highest level of ACEs or PCEs compared to the groups with lower numbers. The magnitude of the risk ratio signifies the strength of the association, where values over 1 indicate a higher risk of youth violence, while values below 1 signify a lower risk of youth violence. For example, a risk ratio of 2 means that the risk or prevalence of the specific violence outcome doubles or increases by 100%; a risk ratio of 1.15 means an increase of 15%, while a risk ratio of 0.80 means that the risk or prevalence is reduced by 20%. Confidence intervals and p-values of estimates are reported as appropriate. The results of the analyses are considered statistically significant if the confidence interval is 95% or higher. All descriptive and inferential analyses use weights that adjust for the complex sampling design in the initial survey of the MCS. There is no adjustment for multiple comparisons in any of the analyses, as this is not deemed strictly necessary or feasible in the current study (Althouse, 2016).

Subgroup analyses

In our analyses, we will additionally examine if the results for our main exposures are moderated by or vary by gender or ethnicity. This will be done by running regression models separately for males and females, and separately for ethnic groups. Interactions between these moderators and the exposures will be examined to determine whether any differences are statistically significant.

Missing data

Missing data analysis

As in all longitudinal studies, there is attrition over time, which disproportionately tends to affect the more disadvantaged participants and, if not addressed correctly, can bias results. Of the 14,088 singleton children born in England and Wales who were initially recruited at age nine

months, 8,069 were still in the study at age 17, with even lower response rates on some specific survey questions relating to youth violence. On the combined age 14 and age 17 youth violence measures, 7,374 had complete data for assault perpetration, 4,924 had data for weapon involvement and 5,004 had data on gang involvement. The lower response rate for the two latter measures is due to the survey instrument used at age 17 for these items, which was an online questionnaire that, for some participants, was completed after the interview visit, which led to additional non-response. Table A2.0.5 (see Appendix) shows the percentage missingness for all variables in the study, including auxiliary variables, which is used to aid the accuracy of the multiple imputations used to address missingness, as described further below.

Missing data analyses were carried out, examining the pattern of missingness on any of the youth violence variables at ages 14 and 17 (4,772 with complete data across all three youth violence outcomes; 9,316 had some missing data). It is well known that attrition and non-response are related to a range of demographic and socioeconomic factors. We also suspected that having a higher propensity for youth violence might be a factor, so antisocial behaviour and conduct problems in all available sweeps were examined in relation to missingness on any of the youth violence outcomes. Table 2.6 shows the results of the logistic regression models, examining each predictor in a separate model (M1–M25). These show that males, ethnic minorities, those born to younger mothers, and those with single parents were more likely to have missing youth violence outcomes. Higher income, higher educational level and higher occupational status were associated with a higher level of response. Antisocial behaviours at ages 11, 14 and 17 and conduct problems from age 3 to 17 were predictive of a higher levels of missingness.

Table 2.6: Predictors of missing data on any youth violence outcomes at ages 14 and 17

		Odds ratio	95% CI
Model			
M1	**Male**	1.55***	1.44–1.66
M2	**Ethnicity** (ref. White)		
	Mixed	1.39***	1.14–1.68
	Asian	1.11+	1.00–1.23
	Black	1.54***	1.29–1.85
	Other	1.44+	0.94–2.21
M3	**Maternal age at birth** (ref 36 or over)		
	Under 20	3.10***	2.60–3.68
	20 to 24	2.18***	1.91–2.48
	25 to 29	1.45***	1.28–1.63
	30 to 35	1.09	0.97–1.22
M4	**Single parent at 9 months**	2.45***	2.20–2.73
M5	**Household income (weekly £100) 9 months**	0.83***	0.81–0.84

M6	**Highest household education** Ref. No qualifications		
	NVQ1 (CGSEs graded less than C)	0.88	0.72–1.08
	NVQ2 (CGSEs graded C or above)	0.58***	0.50–0.68
	NVQ3 (A or AS level)	0.47***	0.40–0.55
	NVQ4 (degree)	0.31***	0.27–0.35
	NVQ5 (postgraduate)	0.21***	0.17–0.25
M7	**Highest household occupational status (**ref. managerial and professional)		
	Intermediate	1.74***	1.56–1.95
	Small employers and self-employed	1.90***	1.64–2.19
	Low supervisory and technical	1.99***	1.76–2.26
	Semi-routine and routine	2.78***	2.53–3.05
	Antisocial behaviours[1]		
M8	Public nuisance, ever (age 11)	1.53***	1.37–1.70
M9	Graffiti, ever (age 11)	1.55***	1.20–1.98
M10	Vandalism, ever (age11)	1.99***	1.51–2.63
M11	Shoplifting, ever (age 11)	1.55***	1.29–1.87
M12	Public nuisance, last 12 months (age 14)	1.57***	1.39–1.79
M13	Graffiti, last 12 months (age 14)	1.09	0.83–1.44
M14	Vandalism, last 12 months (age 14)	1.90***	1.47–2.46
M15	Shoplifting, last 12 months (age 14)	1.34*	1.06–1.69
M16	Theft from a person, last 12 months (age 14)	1.57*	1.03–2.38
M17	Graffiti, last 12 months (age 17)	1.35*	1.02–1.78
M18	Vandalism, last 12 months (age 17)	1.75***	1.35–2.26
M19	Shoplifting, last 12 months (age 17)	1.13	0.93–1.38
	Conduct problems [2]		
M20	Conduct problems SDQ (age 3)	1.11***	1.09–1.13
M21	Conduct problems SDQ (age 5)	1.17***	1.14–1.20
M22	Conduct problems SDQ (age 7)	1.19***	1.16–1.22
M23	Conduct problems SDQ (age 11)	1.21***	1.18–1.24
M24	Conduct problems SDQ (age 14)	1.21***	1.17–1.24
M25	Conduct problems SDQ (age 17)	1.24***	1.20–1.28

*** $p<0.001$, ** $p<0.01$, * $p<0.05$, + $p<0.10$. [1] Binary variables [2] Continuous variables (scale 0–10). Parent reported.
Each predictor is examined in its own logistic regression model (M1–M25)

Multiple imputations

To deal with missing data in the MCS, we use multiple imputations, with a total of 30 data sets being imputed using chained equations. This is essentially a way of restoring missing data, and it is an efficient method for replicating population estimates in longitudinal data when data are missing (Mostafa et al., 2021) under the assumption that there is a pattern to the missingness and that this can be predicted by the observed data (Little and Rubin, 2002). The missing data analyses shown above demonstrate that this assumption is met. To improve the accuracy of imputed values and estimates, several auxiliary variables that were not part of the substantial

analysis but correlated with attrition and non-response were used in imputations (Von Hippel and Lynch, 2013). These include a range of antisocial behaviours at ages 11 and 14, e.g. graffiti, vandalism and shoplifting, and conduct problems at ages 3 to 14. Therefore, the imputation model includes all predictor and outcome variables in the analytical models, i.e. the single ACEs and PCEs, youth violence outcomes, the covariates and the auxiliaries. The sample was imputed back to the initial survey at the age of nine months, using the whole of the UK sample. After imputation, only England and Wales were retained, resulting in a total analytical sample of 14,088. The substantial analyses in this study were carried out by producing a single combined estimate across the 30 imputed data sets using Rubin's rules (Rubin, 2004). All subsequent descriptive and substantial analyses in this study used the imputed sample (N=14,088), except in some models examining ethnic groups where a lack of convergence necessitated the omission of some of the smaller ethnic groups.

Analytical approach to RQ4

To evaluate whether the police.uk data are appropriate to create a measure of neighbourhood violent crime in the context of our research objectives, we compare police.uk data with two well-known and validated data resources: the English and Welsh IMD and the official Home Office statistics of crime.

Police.uk data. The data include monthly street-level incidents of crime reported to the 43 police forces in England and Wales. Crime incidents are grouped in the following 13 categories: bicycle theft, burglary, criminal damage and arson, drugs, other crime, other theft, possession of weapons, public order, robbery, shoplifting, theft from the person, vehicle crime, and violence and sexual offences. The data include the LSOAs of reported crimes and police force codes.

a) Comparability between police.uk and English (2010) and Welsh IMD (2011)

The crime domain of the English IMD 2010 (E-IMD 2010). The crime domain of the E-IMD 2010 combines four major crime types – violence, burglary, theft and criminal damage – to rank LSOAs based on the risk of personal and material victimisation at a small area level. A detailed description of the methodology can be found elsewhere (Communities and Local Government, 2011). In summary, IMD scores and ranks are created by combining the four LSOA-level crime type rates calculated using information from crime counts recorded between April 2008 and March 2009 by 39 regional police forces in England.

• Violence: the rate of violence (19 recorded crime types) per 1,000 at-risk population
• Burglary: the rate of burglary (four recorded crime types) per 1,000 at-risk properties
• Theft: the rate of theft (five recorded crime types) per 1,000 at-risk population

- Criminal damage: the rate of criminal damage (11 recorded crime types) per 1,000 at-risk population

The LSOA crime domain scores and ranks are created as a weighted average of the four indicators, where each one is weighted based on factor analysis techniques.

The Welsh Community Safety Index 2011 (W-IMD 2011). The W-IMD 2011 combines the following seven LSOA-level indicators: police-recorded violent crimes, burglaries, thefts and criminal damage; fire incidences; percentage of adult offenders; and percentage of youth offenders. It uses data from 2009 and 2010 to measure the extent of deprivation relating to living in a safe community (Statistics for Wales, 2011). LSOA ranks and scores are created by combining the seven indicators using weights created with factor analysis techniques.

Comparability

Replicating the IMD in England and Wales using the police.uk data is infeasible because the information they use is not available in the police.uk data, where crime types have been grouped slightly differently. In addition, there are methodological differences between England and Wales that do not allow for comparisons between nations. However, we took several steps to create a measure of crime at the LSOA level in the police.uk data that resembles, as closely as possible, the ranks available in IMD data.

First, we restricted the analysis to crime incidents that are available in the police.uk data and that are used as inputs for IMD ranks in both nations, including the categories violence and sexual offences, burglary, theft, and criminal damage. Second, we focused on crime incidents reported in 2011 because that is the available year closest to the reference period used in E-IMD 2010 and W-IMD 2012. Third, to imitate indicators used to create IMD crime ranks, we created crime rates at the LSOA level using LSOA estimates for the resident population in mid-2011. Finally, we used our derived LSOA crime rates to rank small areas according to their level of violence separately for England and Wales. We created quintiles of LSOA crime ranks separately in the police.uk and the IMD data sets and then evaluated how similarly areas are classified by estimating the percentage of LSOAs that are classified in the same quintiles across both data sets. In the context of our research objective, which aims to classify MCS cohort members living in high/low areas in terms of crime, estimating high agreement rates by quintiles would indicate that the police.uk data and IMD data do a similar job of sorting small areas according to their level of crime. This exercise, although imperfect due to the measurement differences between data sets, allows us to evaluate if LSOA crime ranks based on IMD data differ substantially from ranks created using police.uk data.

Our analysis uses 32,670 LSOAs in England and 1,890 LSOAs in Wales. We exclude 154 and 11 LSOAs, respectively, in England and Wales because changes in boundaries between 2001 and 2011 make it impossible to compare areas.

b) Comparability between police.uk and Home Office data

The open data tables of police-recorded crime and outcomes are created by the Home Office and include official figures of police-recorded crime. Crime incidents in the data are classified into 10 major groups, 31 subgroups and up to 200 offence codes. The 10 major groups are criminal damage and arson, drugs, possession of weapons, public order, robbery, sexual offences, theft, violence against the person, fraud and miscellaneous crimes. The data started in 2007/08 and include counts of crimes at the police force and community safety partnership levels (Home Office, 2016). The data are provided in financial quarters.

Comparability

A homogenisation of crime categories was done to allow comparability between databases because groups and subgroups available in the Home Office data do not coincide perfectly with the 13 categories available in the police.uk data. We used the detailed information provided in the 200 offence codes in the Home Office data to create the same 13 categories available to the police.uk data. Additionally, the variable 'financial year' in the Home Office data was transformed into calendar quarters for comparability with police.uk data across time.

The category 'violence and sexual offences' was used to compare time series between data sets. It includes serious offences, such as death or serious injury, homicide, sexual offences, stalking and harassment, and violence with/without injury, among others. For both data sets, we counted the total number of incidents reported in each calendar quarter from 2011 to 2018 and compared time series between data sets at the national, regional and police force levels.

Additional analyses and robustness checks

A number of additional analyses and robustness checks were carried out for the main RQs that examine ACEs, PCEs and neighbourhood violent crime in relation to youth outcomes (RQ1, RQ2 and RQ5).

For the examination of ACEs (RQ1) and PCEs (RQ2) in relation to youth violence, one potential limitation is that a child's exposure to ACEs and PCEs could be influenced by the child's characteristics and behaviours. Therefore, in additional analyses, conduct problems in early childhood, at age 3, are included as a covariate. As ACEs and PCEs are likely to affect conduct problems, which may, in turn, affect youth violence, these additional models may effectively

underestimate some of the real effects of ACEs and PCEs. However, if the results still hold, then it is very convincing that ACEs and PCEs are not entirely driven by the child's behaviour. Also included in these models are neighbourhood violent crime and neighbourhood deprivation (non-crime IMD), which factor out any confounding effects of the neighbourhood in the associations of ACEs and PCEs with youth violence.

For the examination of neighbourhood violence in relation to youth violence (RQ5), robustness checks included the addition of the four non-crime IMD domains as additional control variables. This is to examine neighbourhood crime over and above general deprivation in the neighbourhood. As additional analyses, we ran models with continuous measures (standardized z scores) of neighbourhood crime to check that the grouping into quintiles does not affect results, as statistical power can be reduced when categorising variables.

Further robustness checks for RQ1, RQ2 and RQ5 included analyses on the non-imputed data, which is the smaller sample for which all data were available prior to the imputation of missing values.

Stata code

All analyses were carried out using Stata version 18 (StataCorp, 2023). The analytical code for the main analyses is available here.

Results

Descriptive summary of the data sets and variables

Sample descriptive analysis

The total analytical sample after imputation includes 14,088 participants, the selected descriptives of which are shown in Table 3.0.1. Children living in England make up most of the sample (79%), and the remaining 21% lived in Wales at the time of the first survey when the children were nine months old. Males make up 51% of the sample and females 49%. The largest ethnic group are those of White background (87%), and the largest ethnic minority group is Asian children (6.4%). In terms of parental education, 37% of children grew up in households where the highest level of education was a university degree (7.5% had a postgraduate degree), and 8.1% of households had no qualifications. Household income during early to late childhood (age nine months to 11 years) was, on average, £373 per week. The average age of mothers when participants were born was 29 years. Most children (63%) grew up in two-parent families from age nine months to age 11 years, while 12% had a single parent in one of the five survey sweeps during this period, and 6.2% of children had a parent who was single in all five sweeps.

Table 3.0.1: Descriptives of sample

	Frequency		95% Confidence Interval	
	Count	Proportion	Lower	Upper
Country				
England	11,087	78.7%	75.4%	81.9%
Wales	3,001	21.3%	18.1%	24.6%
Gender				
Female	6,847	48.6%	47.8%	49.5%
Male	7,241	51.4%	50.5%	52.2%
Ethnicity				
White	12,299	87.3%	85.1%	89.5%
Mixed	454	3.2%	2.8%	3.7%
Asian	902	6.4%	4.7%	8.1%
Black	358	2.5%	1.6%	3.5%
Other	76	0.5%	0.3%	0.7%
Highest household education				
No qualifications	1,141	8.1%	7.2%	9.0%
NVQ1 (CGSEs graded less than C)	831	5.9%	5.4%	6.4%
NVQ2 (CGSEs graded C or above)	3,592	25.5%	24.1%	26.8%
NVQ3 (A or AS level)	2,254	16.0%	15.1%	16.9%
NVQ4 (degree)	5,213	37.0%	35.3%	38.8%
NVQ5 (postgraduate)	1,057	7.5%	6.4%	8.5%

Highest household occupational status				
Managerial and professional	6,430	45.6%	43.4%	47.8%
Intermediate	1,831	13.0%	12.2%	13.8%
Small employers and self-employed	1,043	7.4%	6.8%	8.0%
Low supervisory and technical	1,374	9.7%	9.0%	10.5%
Semi-routine and routine	3,411	24.2%	22.6%	25.8%
Household income (weekly £) sweep 9m to 11y	14,088	£373	£362	£384
Maternal age at birth (years)	14,088	29	28	29
Maternal age at birth (categories)				
Under 20	1,117	7.9%	7.3%	8.6%
20 to 24	2,422	17.2%	16.1%	18.3%
25 to 29	3,918	27.8%	26.8%	28.9%
30 to 35	4,936	35.0%	33.6%	36.5%
36 or over	1,695	12.0%	11.2%	12.9%
Single parent in number of sweeps (age 9m to 11y)				
Never	8,819	62.6%	61.2%	64.1%
One sweep	1,691	12.0%	11.3%	12.7%
Two sweeps	1,085	7.7%	7.1%	8.3%
Three sweeps	845	6.0%	5.5%	6.6%
Four sweeps	775	5.5%	5.0%	6.0%
All five sweeps	873	6.2%	5.6%	6.7%

Notes: Sample size N=14,088 (imputed sample). Results weighted for survey design.

Descriptive analysis: youth violence

Table 3.0.2 shows the prevalences of our three measures of youth violence overall and by a range of sample characteristics. The most prevalent type of youth violence at age 14 or 17 was assault perpetration, which was reported by 42.1% of respondents; weapon involvement had a prevalence of 9.7% and gang involvement 7.0%. There were no discernible differences between England and Wales.

For all types of violence, males were much more likely to engage than females, with the largest difference being for weapon involvement (14.6% male vs 4.6% females), followed by assault perpetration (55.0% males vs 28.5% females) and gang involvement (8.5% males vs 5.3% females).

In terms of ethnicity, the lowest rates of violence across all types of violence were for those of Asian ethnicity, and the highest rates were for those with a Mixed ethnic background (weapon involvement and gang involvement) and for the Black ethnic group (assault perpetration). Although statistically speaking, differences in weapons and gang involvement are not significant due to the relatively low prevalence of these activities combined with the small proportion of ethnic minority groups. We can gauge this by the overlapping confidence intervals around the

estimates. The only significant differences were for assault perpetration, where those of Black ethnicity had significantly higher rates (53%) when compared to both the White (42%) and the Asian group (39.8%).

We see differences in youth violence across different socioeconomic measures, showing the general pattern that those from households with less education, lower income and lower occupational status have higher rates of youth violence. The differences are the most pronounced for gang involvement, followed by weapon involvement, while for assault perpetration, the pattern is much weaker. For example, the prevalence of gang involvement is 14.4% for those in the 20% lowest household income group, compared to 2.7% for those in the 20% highest income group.

There are also clear differences in terms of maternal age, with those born to younger mothers having higher youth violence rates. Of those born to mothers aged 20 or younger, 14.2% reported gang involvement, compared to 4.0% of those born to mothers aged 36 or over. For weapon involvement, this difference was 14.8% vs 7.9%, but for assault perpetration, differences (46.5% vs 40.7%) were not statistically significant, as seen from the overlapping confidence intervals. The highest rates of all types of violence were observed in participants growing up in households with a single parent across all five survey sweeps from age nine months to 11 years, while rates were the lowest in those with two parents in the household across all sweeps.

Table 3.0.2: Descriptives of youth violence at age 14 or 17 overall and by sample characteristics

	Assault perpetration			Weapon involvement			Gang involvement		
		95% CI			95% CI			95% CI	
	Prop	Lower	Upper	Prop	Lower	Upper	Prop	Lower	Upper
England and Wales	42.1%	40.9%	43.2%,	9.7%	8.8%	10.7%	7.0%	6.2%	7.8%
England	42.3%	41.0%	43.6%	9.6%	8.7%	10.6%	6.6%	5.8%	7.4%
Wales	41.4%	38.6%	44.2%	10.1%	8.2%	12.0%	8.3%	6.5%	10.2%
Gender									
Males	55.0%	53.2%	56.7%	14.6%	12.8%	16.3%	8.5%	7.4%	9.7%
Females	28.5%	27.0%	30.0%	4.6%	3.8%	5.5%	5.3%	4.5%	6.1%
Ethnicity									
White	41.7%	40.4%	42.9%	9.9%	8.8%	10.9%	7.0%	6.1%	7.8%
Mixed	47.6%	42.2%	53.0%	12.0%	7.9%	16.0%	9.4%	5.8%	13.1%
Asian	39.8%	36.5%	43.0%	7.5%	5.6%	9.4%	6.1%	4.0%	8.1%
Black	53.3%	47.3%	59.2%	9.2%	5.4%	12.9%	6.1%	3.0%	9.2%
Other	49.2%	35.9%	62.6%	6.5%	-1.1%	14.0%	5.5%	-1.6%	12.7%
Highest household education									
No qualifications	44.3%	40.8%	47.8%	15.8%	12.4%	19.1%	15.2%	12.3%	18.0%

NVQ1 (CGSEs graded less than C)	43.5%	39.2%	47.8%	13.5%	10.2%	16.8%	12.6%	9.4%	15.9%
NVQ2 (CGSEs graded C or above)	41.9%	39.7%	44.2%	11.1%	9.4%	12.9%	8.3%	6.8%	9.8%
NVQ3 (A or AS level)	42.4%	39.6%	45.2%	9.7%	7.7%	11.7%	7.2%	5.8%	8.7%
NVQ4 (degree)	41.4%	39.4%	43.5%	7.8%	6.6%	8.9%	4.2%	3.3%	5.2%
NVQ5 (postgraduate)	41.5%	37.6%	45.5%	5.2%	3.3%	7.0%	2.1%	0.8%	3.4%
Highest household occupational status									
Managerial and professional	40.8%	39.1%	42.5%	7.5%	6.5%	8.4%	4.0%	3.2%	4.8%
Intermediate	40.4%	37.1%	43.7%	9.1%	7.2%	11.1%	6.3%	4.6%	7.9%
Small employers and self-employed	41.6%	37.7%	45.4%	9.4%	6.8%	12.0%	7.0%	4.8%	9.1%
Low supervisory and technical	43.2%	39.9%	46.4%	11.3%	8.4%	14.2%	8.9%	6.6%	11.3%
Semi-routine and routine	45.1%	42.9%	47.2%	13.8%	11.6%	15.9%	12.1%	10.5%	13.8%
Household income (quintiles) sweep 9m to 11y									
Lowest 20%	47.0%	44.3%	49.8%	16.2%	13.7%	18.7%	14.4%	12.0%	16.8%
Lowest 20–40%	44.5%	41.7%	47.3%	12.9%	10.6%	15.1%	10.5%	8.6%	12.4%
Middle 40–60%	41.8%	39.5%	44.2%	9.6%	7.9%	11.3%	6.9%	5.5%	8.3%
Highest 60–80%	39.7%	37.4%	41.9%	7.4%	6.1%	8.7%	4.2%	3.1%	5.3%
Highest 80–100%	39.8%	37.4%	42.3%	6.0%	4.8%	7.2%	2.7%	1.7%	3.7%
Maternal age at birth (categories)									
Under 20	46.5%	42.4%	50.6%	14.8%	11.6%	18.0%	14.2%	11.3%	17.2%
20 to 24	44.9%	42.5%	47.3%	12.5%	10.1%	14.9%	11.2%	9.3%	13.1%
25 to 29	41.4%	39.2%	43.5%	9.5%	8.1%	10.9%	6.6%	5.4%	7.8%
30 to 35	40.7%	38.9%	42.6%	8.0%	6.7%	9.4%	4.5%	3.6%	5.5%
36 or over	40.7%	37.6%	43.8%	7.9%	6.2%	9.7%	4.0%	2.6%	5.5%
Single parent in number of sweeps (age 9m to 11y)									
Never	39.4%	38.1%	40.8%	7.4%	6.4%	8.3%	4.5%	3.6%	5.4%
One sweep	43.0%	39.6%	46.3%	11.4%	9.1%	13.6%	8.7%	6.9%	10.5%
Two sweeps	47.6%	43.7%	51.5%	13.1%	9.7%	16.4%	9.7%	7.1%	12.3%
Three sweeps	46.5%	41.3%	51.8%	12.7%	9.5%	15.9%	11.4%	8.3%	14.4%
Four sweeps	49.0%	44.4%	53.7%	17.4%	13.1%	21.8%	13.5%	9.8%	17.3%
All five sweeps	49.6%	45.6%	53.6%	16.8%	13.1%	20.6%	14.9%	11.6%	18.2%

Notes: sample size N=14,088 (imputed sample). Results weighted for survey design.

Adverse childhood experiences descriptives

Table 3.0.3 shows descriptives for each of the 11 single ACEs and the cumulative measure of the total number of ACEs. The most prevalent ACE was having a single parent, which was experienced by 37.4% during their early to late childhood; this was followed by domestic violence (28.6%) and then parental breakup (28.1%). It should be highlighted that these ACEs are measured in all five survey sweeps, which may contribute to their higher prevalence. Less prevalent, but also measured less frequently in childhood, is physical abuse (5.2%), poor mother–child relationship (9.1%) and parental drug use (13.1%). The average number of ACEs was 2.08 for the sample overall, but males experienced more ACEs than females (2.16 vs 2.0), which is a statistically significant difference. This difference is mainly explained by males being more likely than females

to experience verbal abuse (16.1% vs 10.5%), and physical abuse (6.7% vs 3.7%), whereas other differences were not statistically significant, but they still contribute to males having a higher overall score. Of the 11 ACEs, the maximum number experienced by any participant was nine, which applied to only very few (0.2%). To ensure sufficient statistical power and the generation of meaningful results, the analyses in this study will use categorical measures, capped at six or more ACEs, or with further reduction of categories as analytically appropriate.

Further descriptives of the categorical ACE measures by gender, ethnicity, maternal age, income, education and country are shown in the Appendix (see Tables A3.0.1 to A3.0.6). These indicate that those with the highest level of social and economic disadvantage are more likely to experience a high level of ACEs. For example, 9.5% of those from the lowest 20% income households had six or more ACEs, compared to only 0.7% of those from the highest 80–100% income households (see Appendix Table A3.0.4). There were no significant differences between England and Wales in terms of exposure to ACEs

Table 3.0.3: Single and total number of adverse childhood experiences (ACEs)

	Overall			**Males**			**Females**		
	Prop	95% CI (lower)	95% CI (upper)	**Prop**	95% CI (lower)	95% CI (upper)	**Prop**	95% CI (lower)	95% CI (upper)
Single ACEs									
Single parent	37.4%	35.9%	38.8%	**38.1%**	36.5%	39.7%	**36.6%**	34.9%	38.4%
Parental breakup	28.1%	26.9%	29.3%	**28.8%**	27.4%	30.2%	**27.4%**	25.8%	29.0%
Domestic violence	28.6%	27.8%	29.5%	**28.8%**	27.6%	30.0%	**28.5%**	27.3%	29.6%
Verbal abuse	13.3%	12.5%	14.2%	**16.1%**	15.0%	17.2%	**10.5%**	9.5%	11.5%
Physical abuse	5.2%	4.7%	5.8%	**6.7%**	5.9%	7.5%	**3.7%**	3.2%	4.3%
Parental alcohol abuse	20.7%	19.7%	21.8%	**20.9%**	19.6%	22.1%	**20.6%**	19.3%	21.9%
Parental drug use	13.1%	12.3%	14.0%	**13.5%**	12.4%	14.6%	**12.8%**	11.7%	13.8%
Parental mental health	21.8%	20.8%	22.8%	**22.0%**	20.8%	23.1%	**21.6%**	20.3%	22.9%
Poor parental relationship	17.1%	11.5%	22.7%	**17.2%**	11.9%	22.6%	**17.0%**	11.9%	22.1%
Poor mother–child relationship	9.1%	7.6%	10.5%	**10.3%**	8.5%	12.0%	**7.8%**	6.4%	9.1%
Maternal long-term disability/illness	13.2%	12.5%	14.0%	**13.5%**	12.4%	14.5%	**13.0%**	11.9%	14.0%
Mean number of ACEs	2.08	2.01	2.14	**2.16**	2.09	2.23	**2.00**	1.92	2.07
Number of ACEs									
0	19.5%	18.4%	20.6%						
1	23.8%	22.7%	24.8%						
2	21.8%	20.9%	22.8%						
3	15.4%	14.6%	16.3%						
4	10.0%	9.3%	10.7%						
5	5.4%	4.8%	5.9%						
6	2.5%	2.1%	2.9%						

7	1.1%	0.9%	1.3%
8	0.4%	0.2%	0.5%
9	0.2%	0.1%	0.2%
10	0.0%	0.0%	0.0%
11	0.0%	0.0%	0.0%
Number of ACEs (reduced categories)			
No ACEs	19.5%	18.4%	20.6%
One ACE	23.8%	22.7%	24.8%
Two ACEs	21.8%	20.9%	22.8%
Three ACEs	15.4%	14.6%	16.3%
Four ACEs	10.0%	9.3%	10.7%
Five ACEs	5.4%	4.8%	5.9%
Six or more ACEs	4.1%	3.6%	4.7%

Notes: sample size N=14,088 (imputed sample). Results weighted for survey design. CI=confidence interval

Positive childhood experiences descriptives

Table 3.0.4 shows descriptives for each of the seven single PCEs and the cumulative measure of the total number of PCEs. The most prevalent PCE was having low-risk peers (86.7%), followed by engaging in activities and hobbies (73.7%) and living in a safe neighbourhood (68.5%). The least common were good school connectedness (23.7%) and positive teacher–child relationships (34.9%). Overall, participants experienced an average of 3.8 PCEs, with females experiencing more than males (4.03 vs 3.57). This was driven by a higher prevalence among females of good school connectedness (31.0% vs 16.7%), positive teacher–child relationships (40.8 vs 29.2%), low-risk peers (89.4% vs 84.2%) and engagement in activities and hobbies (80.6% vs 67.2%). Of the seven PCEs, a small proportion of participants experienced all seven PCEs (3.2%) and only a few experienced none (0.8%). For further analyses for this study, we combine those with six to seven PCEs, making up 12.9% of the sample, and we combine those with zero to two PCEs, totalling 19.0%. In some analyses, we further reduce the measure into fewer categories to ensure enough statistical power to generate meaningful results.

Further descriptives of the categorical ACE measures by gender, ethnicity, maternal age, income, education and country are shown in the Appendix (see Tables A3.0.7 to A3.0.12). These show that those with the highest level of social and economic advantage tended to have a high level of PCEs. For example, 18.2% of those from households with the 80–100% highest income had six to seven PCEs, compared to only 6.9% of those from households with the 20% lowest income (see Appendix Table A3.0.10). There were no differences between England and Wales in terms of PCEs.

Table 3.0.4: Single and total number of positive childhood experiences (PCEs)

	Overall			Males			Females		
	Prop	95% CI (lower)	95% CI (upper)	Prop	95% CI (lower)	95% CI (upper)	Prop	95% CI (lower)	95% CI (upper)
Single PCEs									
Good school connectedness	23.7%	18.8%	28.5%	16.7%	13.0%	20.4%	31.0%	25.1%	36.8%
Positive teacher–child relationship	34.9%	33.8%	36.0%	29.2%	27.8%	30.7%	40.8%	39.4%	42.2%
Feeling safe in the playground	58.5%	57.6%	59.5%	58.2%	56.8%	59.5%	58.9%	57.5%	60.3%
Safe neighbourhood	68.5%	67.2%	69.9%	68.4%	66.7%	70.0%	68.7%	67.1%	70.4%
Low-risk peers	86.7%	85.9%	87.6%	84.2%	82.9%	85.5%	89.4%	88.4%	90.4%
Positive peer experiences	33.5%	32.4%	34.6%	33.5%	32.0%	34.9%	33.5%	32.0%	35.0%
Activities and hobbies	73.7%	72.5%	74.9%	67.2%	65.5%	68.9%	80.6%	79.3%	81.9%
Mean number of PCEs	3.80	3.74	3.85	3.57	3.52	3.63	4.03	3.96	4.10
Number of PCEs									
0	0.8%	0.6%	1.0%						
1	4.7%	4.2%	5.3%						
2	13.5%	12.5%	14.4%						
3	23.7%	22.7%	24.7%						
4	25.8%	24.7%	27.0%						
5	18.6%	17.7%	19.5%						
6	9.7%	8.6%	10.7%						
7	3.2%	2.7%	3.8%						
Number of PCEs (reduced categories)									
0–2 PCEs	19.0%	17.9%	20.1%						
3 PCEs	23.7%	22.7%	24.7%						
4 PCEs	25.8%	24.7%	27.0%						
5 PCEs	18.6%	17.7%	19.5%						
6–7 PCEs	12.9%	11.5%	14.3%						

Notes: sample size N=14,088 (imputed sample). Results weighted for survey design. CI=confidence interval

Adverse childhood experiences by positive childhood experiences

Table 3.0.5 reports the prevalence of ACEs by PCEs. This shows a clear reverse association between these measures. More specifically, 1.2% of those with six to seven PCEs had six or more ACEs, compared to 8.9% of those with zero to two PCEs. And 28.5% of those with six to seven PCEs had no ACEs, compared to 10.2% of those with zero to two PCEs.

Table 3.0.5 Adverse childhood experiences (ACEs) by positive childhood experiences (PCEs)

	Prop	95% CI lower	95% CI upper
No ACEs 0–2 PCEs	10.2%	8.7%	11.8%
No ACEs 3 PCEs	16.6%	14.7%	18.5%
No ACEs 4 PCEs	20.8%	18.7%	22.8%
No ACEs 5 PCEs	24.6%	22.3%	26.9%
No ACEs 6–7 PCEs	28.5%	25.7%	31.3%
One ACE 0–2 PCEs	18.7%	16.7%	20.6%
One ACE 3 PCEs	23.2%	21.3%	25.2%
One ACE 4 PCEs	24.2%	22.1%	26.3%
One ACE 5 PCEs	26.2%	23.7%	28.7%
One ACE 6–7 PCEs	27.8%	25.3%	30.3%
Two ACEs 0–2 PCEs	21.4%	19.3%	23.6%
Two ACEs 3 PCEs	22.4%	20.5%	24.3%
Two ACEs 4 PCEs	22.9%	20.9%	24.9%
Two ACEs 5 PCEs	21.6%	19.3%	23.8%
Two ACEs 6–7 PCEs	19.5%	17.1%	21.8%
Three ACEs 0–2 PCEs	18.2%	16.3%	20.2%
Three ACEs 3 PCEs	16.7%	15.0%	18.3%
Three ACEs 4 PCEs	14.8%	13.0%	16.5%
Three ACEs 5 PCEs	13.4%	11.6%	15.2%
Three ACEs 6–7 PCEs	13.2%	11.2%	15.2%
Four ACEs 0–2 PCEs	13.9%	12.1%	15.6%
Four ACEs 3 PCEs	11.0%	9.6%	12.4%
Four ACEs 4 PCEs	9.6%	8.1%	11.1%
Four ACEs 5 PCEs	7.6%	6.2%	9.0%
Four ACEs 6–7 PCEs	6.8%	5.4%	8.2%
Five ACEs 0–2 PCEs	8.6%	7.1%	10.1%
Five ACEs 3 PCEs	5.6%	4.5%	6.7%
Five ACEs 4 PCEs	4.8%	3.9%	5.8%
Five ACEs 5 PCEs	4.0%	3.0%	5.1%
Five ACEs 6–7 PCEs	3.0%	1.9%	4.1%
Six or more ACEs 0–2 PCEs	8.9%	7.5%	10.4%
Six or more ACEs 3 PCEs	4.5%	3.5%	5.5%
Six or more ACEs 4 PCEs	2.9%	2.1%	3.6%
Six or more ACEs 5 PCEs	2.6%	1.7%	3.4%
Six or more ACEs 6–7 PCEs	1.2%	0.6%	1.8%

Notes: sample size N=14,088 (imputed sample). Results weighted for survey design. CI=confidence interval

Correlation between single adverse childhood experiences and positive childhood experiences

Table 3.0.6 shows bivariate correlations between each of the single ACEs and PCEs. Because these are all binary variables, tetrachoric correlations were obtained. We find that ACEs tend to be positively correlated with each other, meaning that if one of the ACEs is present, it is more likely than not that the other ACE is also present. The only exception to this pattern is single parent status, which had a negative correlation with parental alcohol abuse and domestic violence.

While some correlations were very small and close to zero, others were more substantial when these had a common theme, such as a poor parental relationship and domestic violence or a poor parent–child relationship and verbal and physical abuse towards the child. When we look at correlations between single PCEs, there is a similar pattern of items being positively correlated, with no negative correlations and only very few that were close to zero. Good school connectedness especially had some of the highest correlations with other PCEs, especially for positive teacher relationships. These correlations would be expected. The point of the ACE and PCE frameworks is to add up the risks rather than control for all other risks at the same time, which is what is so often done in research that examines a single particular aspect of childhood. But this ignores the exposure to multiple risks.

ACEs and PCEs tended to be negatively correlated, with only very few exceptions. Living in a safe neighbourhood had some of the strongest negative bivariate associations with ACEs, and single parent status had some of the strongest negative correlations with PCEs. A likely reason for these correlations is that these are underpinned by socioeconomic status, which is associated with both ACEs and PCEs, as shown in previous descriptive analyses.

Table 3.0.6: Correlations between single adverse childhood experiences (ACEs) and positive childhood experiences (PCEs)

		Single parent	Parental breakup	Domestic violence	Verbal abuse	Physical abuse	Parental alcohol abuse	Parental drug use	Parental mental health	Poor parental relationship	Poor parent–child relationship	Parental longterm disability/illness	Good school connectedness	Positive relationship with teachers	Feeling safe in then school playground	Low-risk peers	Positive peer experiences	Participation in activities and hobbies	Living in a safe neighbourhood
ACEs	Single parent	1.00																	
	Parental breakup	0.83	1.00																
	Domestic violence	−0.08	0.14	1.00															
	Verbal abuse	0.15	0.08	0.06	1.00														
	Physical abuse	0.10	0.05	0.10	0.60	1.00													
	Parental alcohol abuse	−0.10	0.02	0.18	0.00	0.00	1.00												
	Parental drug use	0.11	0.18	0.24	0.03	0.01	0.26	1.00											
	Parental mental health	0.17	0.15	0.21	0.21	0.15	0.09	0.16	1.00										
	Poor parental relationship	0.09	0.28	0.42	0.10	0.08	0.14	0.22	0.37	1.00									
	Poor parent–child relationship	0.16	0.08	0.10	0.32	0.25	0.03	0.09	0.37	0.20	1.00								
	Parental long-term disability/illness	0.16	0.12	0.09	0.08	0.01	0.04	0.10	0.36	0.14	0.14	1.00							
PCEs	Good school connectedness	−0.14	−0.10	−0.03	−0.10	−0.08	−0.04	−0.09	−0.05	−0.08	−0.10	−0.08	1.00						
	Positive relationship with teachers	−0.11	−0.06	−0.03	−0.06	−0.06	0.01	−0.07	−0.05	−0.04	−0.09	−0.02	0.35	1.00					
	Feeling safe in the school playground	−0.06	−0.04	−0.03	−0.05	−0.02	0.00	−0.04	−0.06	−0.02	−0.09	−0.07	0.22	0.09	1.00				
	Low-risk peers	−0.19	−0.14	−0.04	−0.11	−0.09	−0.01	−0.12	−0.13	−0.03	−0.15	−0.12	0.24	0.24	0.09	1.00			
	Positive peer experiences	−0.11	−0.10	−0.04	−0.10	−0.06	−0.02	−0.07	−0.10	−0.07	−0.13	−0.08	0.30	0.19	0.24	0.25	1.00		
	Participation in activities and hobbies	−0.13	−0.09	−0.01	−0.12	−0.09	−0.01	−0.02	−0.13	−0.07	−0.12	−0.07	0.23	0.15	0.05	0.14	0.02	1.00	
	Living in a safe neighbourhood	−0.27	−0.14	−0.06	−0.10	−0.06	0.04	−0.06	−0.25	−0.12	−0.19	−0.16	0.11	0.12	0.08	0.12	0.09	0.12	1.00

Notes: sample size N=14,088 (imputed sample). Results weighted for survey design.

Neighbourhood crime descriptives

Table 3.0.7 and Table 3.0.8 show descriptive statistics for the measures of neighbourhood crime used in the analyses. Neighbourhoods are LSOA areas, and measures of crime are annual rates per 1,000 population based on data from 2012 and 2013. The average number of neighbourhood violent crimes was 11.1, ranging from 0–224.4 (see Table 3.0.7), and the average number of general neighbourhood crimes was 38.7, ranging from 0.7–634.2 (see Table 3.0.8). The correlation between these measures is very high (r=0.89), suggesting that neighbourhoods with a high level of violent crime also have a high level of general crime. It is worth noting that neighbourhood violence makes up one aspect of the measure of general neighbourhood crime, so these measures are not independent. In most analyses, neighbourhood crime will be examined as quintiles (five equal proportions) and shown in the tables are the mean values and ranges in each quintile for violent and general crime.

Further descriptives of neighbourhood violent crime and neighbourhood general crime by demographic and socioeconomic measures are shown in the Appendix (see Tables A3.0.13 to A3.0.22). These show that those with social and economic disadvantage are more likely to reside in neighbourhoods with a high level of crime. For example, 31.2% of those from the lowest 20% income households lived in neighbourhoods with the 80–100% highest level of violent crime, compared to 5.7% of those from the highest 80–100% income households (see Table A3.0.15). There were also notable ethnic differences, as 45.1% of those of Black ethnic background lived in neighbourhoods with the 80–100% highest level of violent crime, compared to 13.4% of those of White ethnic background, 22.5% of Mixed ethnic background, and 29.1% of those of Asian ethnic background (see Table A3.0.13). A similar pattern was seen for neighbourhood general crime.

Table 3.0.7: Neighbourhood violent crime (annual rates per 1,000 population)

	Mean	95% CI (lower)	95% CI (upper)	Range
All neighbourhoods	**11.1**	10.9	11.3	**0–224.4**
Lowest 20% neighbourhood violent crime	2.5	2.4	2.5	0–3.9
Lowest 20-40% neighbourhood violent crime	5.2	5.2	5.23	3.9–6.6
Middle 40-60% neighbourhood violent crime	8.5	8.5	8.6	6.6–10.7
Highest 60-80% neighbourhood violent crime	13.3	13.2	13.3	10.7–16.5
Highest 80-100% neighbourhood violent crime	25.8	25.4	26.4	16.5–224.4

Notes: sample size N=14,088 (imputed sample). Results weighted for survey design. CI=confidence interval

Table 3.0.8: Neighbourhood general crime (annual rates per 1,000 population)

	Mean	95% CI (lower)	95% CI (upper)	Range
All neighbourhoods	**38.7**	**38.2**	**39.2**	**0.7–634.2**
Lowest 20% neighbourhood violent crime	13.3	13.1	13.4	0.7–18.5
Lowest 20–40% neighbourhood violent crime	22.9	22.8	23.0	18.5–27.1
Middle 40–60% neighbourhood violent crime	31.9	31.9	32.0	27.2–37.3
Highest 60–80% neighbourhood violent crime	44.2	44.0	44.3	37.3–52.5
Highest 80–100% neighbourhood violent crime	81.3	79.6	83.0	52.5–634.2

Notes: sample size N=14,088 (imputed sample). Results weighted for survey design. CI=confidence interval

by neighbourhood crime

Table 3.0.9 reports levels of ACEs by levels of neighbourhood violent crime. This shows that having a high number of ACEs is more prevalent as the level of neighbourhood violent crime increases. We see that 6.1% of those in the most violent neighbourhoods had six or more ACEs, compared to 2.1% of those in the neighbourhoods with the lowest level of violence. A similar pattern is found for neighbourhood general crime (see Appendix Table A3.0.23).

Table 3.0.9: Adverse childhood experiences (ACEs) by neighbourhood violent crime

	Prop	95% CI (lower)	95% CI (upper)
No ACEs | Lowest 20% area violence	26.3%	24.1%	28.5%
No ACEs | Lowest 20–40% area violence	21.3%	19.3%	23.4%
No ACEs | Middle 40–60%	18.0%	15.9%	20.1%
No ACEs | Highest 60–80% area violence	15.2%	13.4%	17.0%
No ACEs | Highest 80–100% area violence	12.4%	10.6%	14.2%
One ACE | Lowest 20% area violence	26.0%	24.1%	27.9%
One ACE | Lowest 20–40% area violence	25.3%	23.2%	27.5%
One ACE | Middle 40–60%	22.4%	20.4%	24.4%
One ACE | Highest 60–80% area violence	22.2%	20.0%	24.5%
One ACE | Highest 80–100% area violence	21.2%	19.2%	23.3%
Two ACEs | Lowest 20% area violence	20.6%	18.8%	22.4%
Two ACEs | Lowest 20–40% area violence	21.4%	19.4%	23.5%
Two ACEs | Middle 40–60%	21.6%	19.6%	23.7%
Two ACEs | Highest 60–80% area violence	23.3%	21.1%	25.5%
Two ACEs | Highest 80–100% area violence	23.0%	21.0%	25.0%
Three ACEs | Lowest 20% area violence	13.6%	12.1%	15.2%
Three ACEs | Lowest 20–40% area violence	15.1%	13.4%	16.8%
Three ACEs | Middle 40–60%	15.9%	14.1%	17.7%
Three ACEs | Highest 60–80% area violence	15.6%	13.8%	17.4%
Three ACEs | Highest 80–100% area violence	18.0%	16.0%	20.0%
Four ACEs | Lowest 20% area violence	7.8%	6.4%	9.2%
Four ACEs | Lowest 20–40% area violence	8.9%	7.6%	10.1%
Four ACEs | Middle 40–60%	11.2%	9.4%	12.9%
Four ACEs | Highest 60–80% area violence	11.6%	9.9%	13.2%
Four ACEs | Highest 80–100% area violence	12.1%	10.6%	13.7%
Five ACEs | Lowest 20% area violence	3.7%	2.7%	4.6%
Five ACEs | Lowest 20–40% area violence	4.8%	3.8%	5.7%

Five ACEs | Middle 40–60%	5.9%	4.7%	7.0%
Five ACEs | Highest 60–80% area violence	6.4%	5.0%	7.8%
Five ACEs | Highest 80–100% area violence	7.1%	5.7%	8.6%
Six or more ACEs | Lowest 20% area violence	2.1%	1.5%	2.7%
Six or more ACEs | Lowest 20–40% area violence	3.2%	2.3%	4.0%
Six or more ACEs | Middle 40–60%	5.0%	3.8%	6.1%
Six or more ACEs | Highest 60–80% area violence	5.7%	4.5%	7.0%
Six or more ACEs | Highest 80–100% area violence	6.1%	4.7%	7.5%

Notes: sample size N=14,088 (imputed sample). Results weighted for survey design. CI=confidence interval

Positive childhood experiences by neighbourhood crime

Table 3.0.10 shows levels of PCEs by levels of neighbourhood violent crime. Having a high number of PCEs is more common for those in neighbourhoods with low levels of neighbourhood violent crime. Of those in the least violent neighbourhoods, 16.5% had six to seven PCEs, compared to 9.2% of those in neighbourhoods with the highest level of violence. A similar pattern is seen for neighbourhood general crime (see Appendix Table A3.0.24).

Table 3.0.10: Positive childhood experiences (PCEs) by neighbourhood violent crime

	Prop	95% CI lower	95% CI upper
Zero to two PCEs | Lowest 20% area violence	12.5%	10.8%	14.2%
Zero to two PCEs | Lowest 20–40% area violence	16.3%	14.2%	18.4%
Zero to two PCEs | Middle 40–60%	20.4%	18.3%	22.6%
Zero to two PCEs | Highest 60–80% area violence	23.3%	21.1%	25.6%
Zero to two PCEs | Highest 80–100% area violence	26.8%	24.4%	29.3%
Three PCEs | Lowest 20% area violence	22.1%	20.0%	24.2%
Three PCEs | Lowest 20–40% area violence	22.5%	20.4%	24.6%
Three PCEs | Middle 40–60%	24.9%	22.7%	27.2%
Three PCEs | Highest 60–80% area violence	25.5%	23.5%	27.5%
Three PCEs | Highest 80–100% area violence	24.6%	22.6%	26.7%
Four PCEs | Lowest 20% area violence	27.9%	25.6%	30.3%
Four PCEs | Lowest 20–40% area violence	27.1%	24.8%	29.5%
Four PCEs | Middle 40–60%	25.1%	22.8%	27.4%
Four PCEs | Highest 60–80% area violence	24.0%	21.7%	26.4%
Four PCEs | Highest 80–100% area violence	23.5%	21.2%	25.8%
Five PCEs | Lowest 20% area violence	20.9%	19.2%	22.6%
Five PCEs | Lowest 20–40% area violence	20.4%	18.5%	22.3%
Five PCEs | Middle 40–60%	17.5%	15.7%	19.4%
Five PCEs | Highest 60–80% area violence	16.4%	14.4%	18.4%
Five PCEs | Highest 80–100% area violence	15.8%	13.9%	17.7%
Six to seven PCEs | Lowest 20% area violence	16.5%	14.4%	18.7%
Six to seven PCEs | Lowest 20–40% area violence	13.7%	11.7%	15.7%
Six to seven PCEs | Middle 40–60%	12.0%	10.1%	13.9%
Six to seven PCEs | Highest 60–80% area violence	10.7%	9.0%	12.5%
Six to seven PCEs | Highest 80–100% area violence	9.2%	7.6%	10.9%

Notes: sample size N=14,088 (imputed sample). Results weighted for survey design. CI=confidence interval

Adverse childhood experiences in relation to youth violence

Results for RQ1a: which single and cumulative adverse childhood experiences are associated with youth violence, and what are the magnitudes of the associations?

Association between adverse childhood experiences and assault perpetration

The association of each of the single ACEs with assault perpetration is shown in Table 3.1.1, where each ACE is examined in its own regression model (M1–M11). The risk ratio represents the relative difference in risk of assault perpetration between those exposed to the ACE compared to those not exposed, adjusted for covariates. We see that the strongest association is for having a single parent (risk ratio [RR]=1.17, p<0.01), which means that this ACE is associated with a 17% increase in the risk of assault perpetration. This is followed by parental drug use, which is associated with a 16% increase (RR=1.16, p<0.01); domestic violence, which is associated with a 13% increase (RR=1.13, p<0.001); and parental alcohol abuse, which is also associated with a 13% increase (RR=1.13, p<0.001). The weakest associations, none of which are statistically significant, are for poor parent–child relationships, parental mental health and physical abuse.

Table 3.1.1: Risk of assault perpetration for single adverse childhood experiences (ACEs)

Model		RR
M1	Single parent	1.17**
M2	Parental breakup	1.04
M3	Domestic violence	1.13***
M4	Verbal abuse	1.08*
M5	Physical abuse	1.05
M6	Parental alcohol abuse	1.13***
M7	Parental drug use	1.16***
M8	Parental mental health	1.03
M9	Poor parental relationship	1.08*
M10	Poor parent–child relationship	1.02
M11	Parental long-term disability/illness	1.11**

Notes: each ACE is examined in a separate logistic regression model. The models adjust for sex at birth, ethnicity, maternal age at birth, income, education, occupational status, the number of sweeps in which the parent was single and PCEs. *** p<0.001, ** p<0.01, * p<0.05, + p<0.10. Sample size N=14,088 (imputed sample). Results weighted for survey design.

Next, the cumulative number of ACEs is examined in relation to assault perpetration, the results of which are presented in Figure 3.1.1 and Table 3.1.2. There is a clear pattern that as the number of ACEs in childhood increases, so does the risk of perpetrating assault in adolescence. For those with six or more ACEs, the prevalence of assault perpetration is 54.4%

compared to 36.2% for those with no ACEs, which is a risk ratio of 1.45 (p<0.001) or an increase in risk of 45%.

Figure 3.1.1: Prevalence of assault perpetration by number of adverse childhood experiences (ACEs)
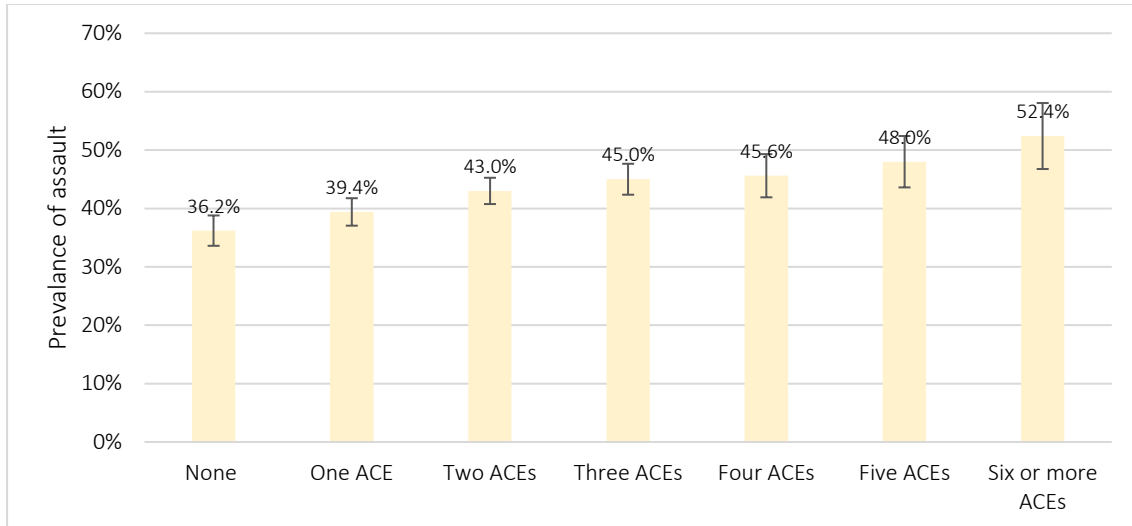
Notes: adjusted for sex at birth, ethnicity, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single and PCEs. Capped lines indicate 95% confidence intervals. Sample size N=14,088 (imputed sample). Results weighted for survey design.

Table 3.1.2: Prevalence of assault perpetration by number of adverse childhood experiences (ACEs) and associated risk ratios (RR)

	Prevalence	RR
ACEs		
None	36.2%	Ref
One ACE	39.4%	1.09+
Two ACEs	43.0%	1.19***
Three ACEs	45.0%	1.24***
Four ACEs	45.6%	1.26***
Five ACEs	48.0%	1.33***
Six or more ACEs	52.4%	1.45***

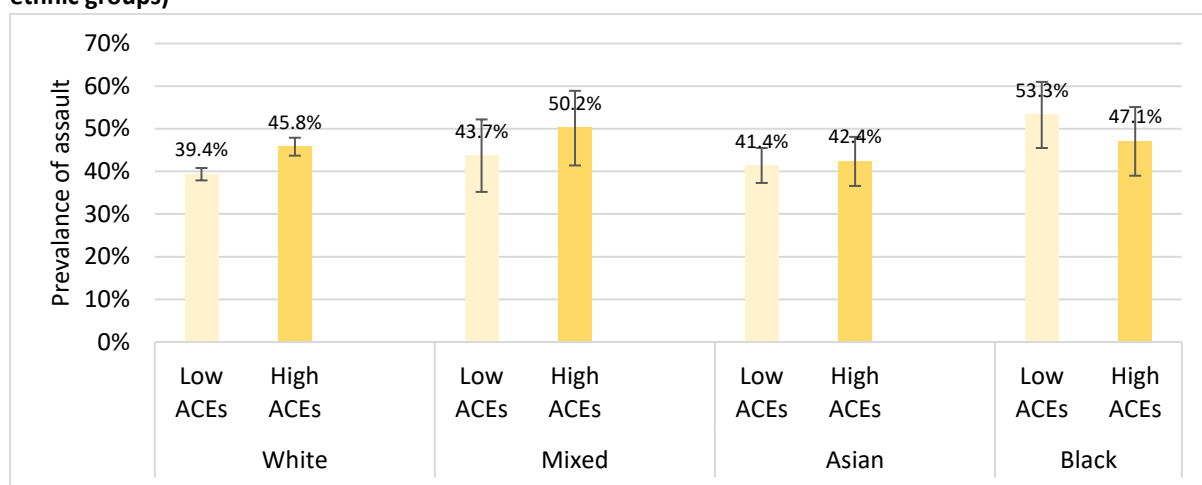Notes: model adjusts for sex at birth, ethnicity, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single and PCEs.
*** p<0.001, ** p<0.01, * p<0.05, + p<0.10
Sample size N=14,088 (imputed sample). Results weighted for survey design.

Examination by gender

Figure 3.1.2 and Table 3.1.3 show the prevalence of assault perpetration by the number of ACEs for males and females. We observe a slightly steeper gradient for females between the bars in the figure, suggesting that the association between ACEs and assault perpetration is stronger for females. This is reflected also in the larger risk ratios when comparing those with different levels of ACEs to those with no ACEs. For males with six or more ACEs, we see a 34% increase in assault perpetration (RR=1.34, p<0.001), whereas for females, the increase is

somewhat higher at 69% (RR=1.69, p<0.01). For lower levels of ACEs, the increased risk of assault perpetration is also higher for females. These gender differences range from being borderline (p<0.10) to fully statistically significant (p<0.05), as seen in the last column in Table 3.1.3.

Figure 3.1.2: Prevalence of assault perpetration by number of adverse childhood experiences (ACEs) (males vs females)
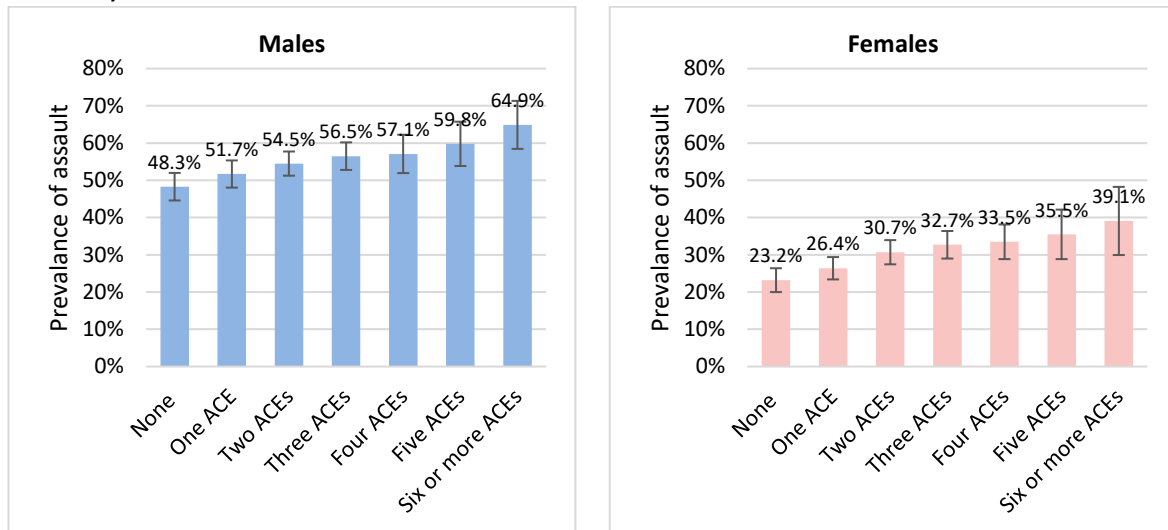
Notes: models adjust for ethnicity, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single and PCEs. Capped lines indicate 95% confidence intervals. Sample size N=14,088 (imputed sample). Males N=7,241, females N=6,847. Results weighted for survey design.

Table 3.1.3: Prevalence of assault perpetration by number of adverse childhood experiences (ACEs) and associated risk ratios (RR) (males vs females)

	Males		Females		Gender difference (males)
	Prevalence	RR	Prevalence	RR	RR
ACEs					
None	48.3%	Ref	23.2%	Ref	Ref
One ACE	51.7%	1.07	26.4%	1.14	0.92
Two ACEs	54.5%	1.13**	30.7%	1.32*	0.83+
Three ACEs	56.5%	1.17***	32.7%	1.41**	0.81*
Four ACEs	57.1%	1.18**	33.5%	1.44**	0.79*
Five ACEs	59.8%	1.24***	35.5%	1.53**	0.78+
Six or more ACEs	64.9%	1.34***	39.1%	1.69**	0.76+

Notes: models adjust for ethnicity, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single and PCEs. Gender differences were examined in an interaction model. *** p<0.001, ** p<0.01, * p<0.05, + p<0.10. Sample size N=14,088 (imputed sample). Males N=7,241, females N=6,847. Results weighted for survey design.

Examination by ethnicity

Ethnicity was explored in Figure 3.1.3 and Table 3.1.4, which compared the Asian, Black, Mixed and White ethnic groups. ACEs were reduced to binary measures (high vs low), as it was not possible to meaningfully examine the expanded version of ACEs alongside multiple

ethnic groups. We see that for the Mixed and White ethnic groups, the association is largely similar: those with high levels of ACEs have a higher prevalence of assault perpetration. For the Asian ethnic group, the risk of assault perpetration was largely the same in the high and low ACE groups, while in the Black ethnic group, the association was reversed, meaning that those with low ACEs had a higher risk of assault perpetration. It should be noted that the difference in assault between the high and low ACEs groups was not statistically significant within any of the ethnic minority groups, where statistical power is limited because of the small group sizes. However, the difference between the risk ratios in the Black and White ethnic groups was statistically significant (RR=0.76, p<0.05) due to the association between ACEs and assault perpetration going in opposite directions in these groups.

Figure 3.1.3: Prevalence of assault perpetration by high vs low adverse childhood experiences (ACEs) (by ethnic groups)

Notes: the Other ethnicity category had very small numbers (N=76), so to enable analyses to run and converge, this had to be dropped from the analyses. Models adjust for gender, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single and PCEs. Capped lines indicate 95% confidence intervals. Sample size N=14,012 (imputed sample). Asian N=902, Black N=358, Mixed N=454, White N=12,299. Results weighted for survey design.

Table 3.1.4: Prevalence of assault perpetration by high vs low adverse childhood experiences (ACEs) and associated risk ratios (RR) (by ethnic groups)

	Low ACEs (0–2) Prevalence	High ACEs (3+) Prevalence	High vs Low ACEs RR	Ethnic differences RR
White	39.4%	45.8%	1.16***	Ref
Mixed	43.7%	50.2%	1.15	0.99
Asian	41.4%	42.4%	1.02	0.88
Black	53.3%	47.1%	0.88	0.76*

Notes: the Other ethnicity category had very small numbers (N=76), so to enable analyses to run and converge, this had to be dropped from the analyses. Models adjust for gender, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single and PCEs. Ethnic differences were examined in an interaction model. *** p<0.001, ** p<0.01, * p<0.05, + p<0.10. Sample size N=14,012 (imputed sample). Asian N=902, Black N=358, Mixed N=454, White N=12,299. Results weighted for survey design.

Association between adverse childhood experiences and weapon involvement

The association between each of the single ACEs and weapon involvement in adolescence is presented in Table 3.1.5, showing results from 11 separate models controlling for covariates. The strongest association was for parental drug use, which is associated with a 51% increase in risk of weapon involvement (RR=1.51, p<0.001). This is followed by single parent status, associated with a 38% increase (RR=1.38, p<0.05) and domestic violence, associated with a 35% increase (RR=1.35, p<0.001). The weakest associations, none of which were statistically significant, were poor parent–child relationship, verbal abuse and parental breakup, and poor parental relationship, especially, had a very weak association.

Figure 3.1.4 and Table 3.1.6 show the association between the number of ACEs in childhood and weapon involvement. Those with six or more ACEs were 2.5 times more likely to report weapon involvement than those with no ACEs (RR=2.50, p<0.001), equivalent to a 150% increase, with prevalences of 15.4% vs 6.2% in these respective groups.

Table 3.1.5: Risk of weapon involvement for single adverse childhood experiences (ACEs)

Model		RR
M1	Single parent	1.38*
M2	Parental breakup	1.13
M3	Domestic violence	1.35***
M4	Verbal abuse	1.11
M5	Physical abuse	1.20
M6	Parental alcohol abuse	1.35**
M7	Parental drug use	1.51***
M8	Parental mental health	1.21+
M9	Poor parental relationship	1.13
M10	Poor parent–child relationship	1.03
M11	Parental long-term disability/illness	1.31**

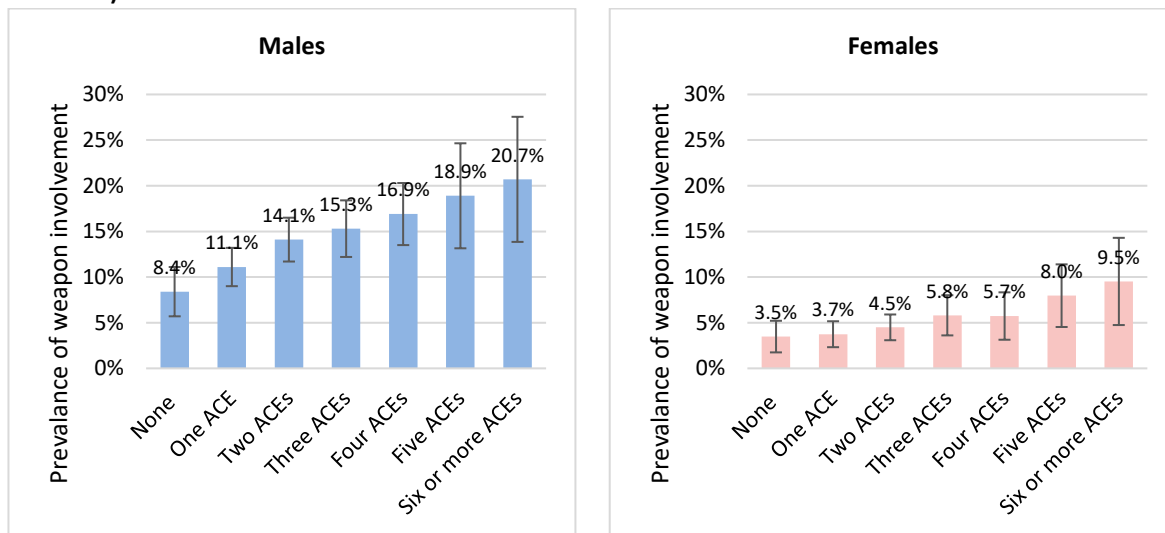Notes: each ACE is examined in a separate logistic regression model. The models adjust for sex at birth, ethnicity, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single and PCEs. *** p<0.001, ** p<0.01, * p<0.05, + p<0.10. Sample size N=14,088 (imputed sample). Results weighted for survey design. RR=risk ratio

Figure 3.1.4: Prevalence of weapon involvement by number of adverse childhood experiences (ACEs)
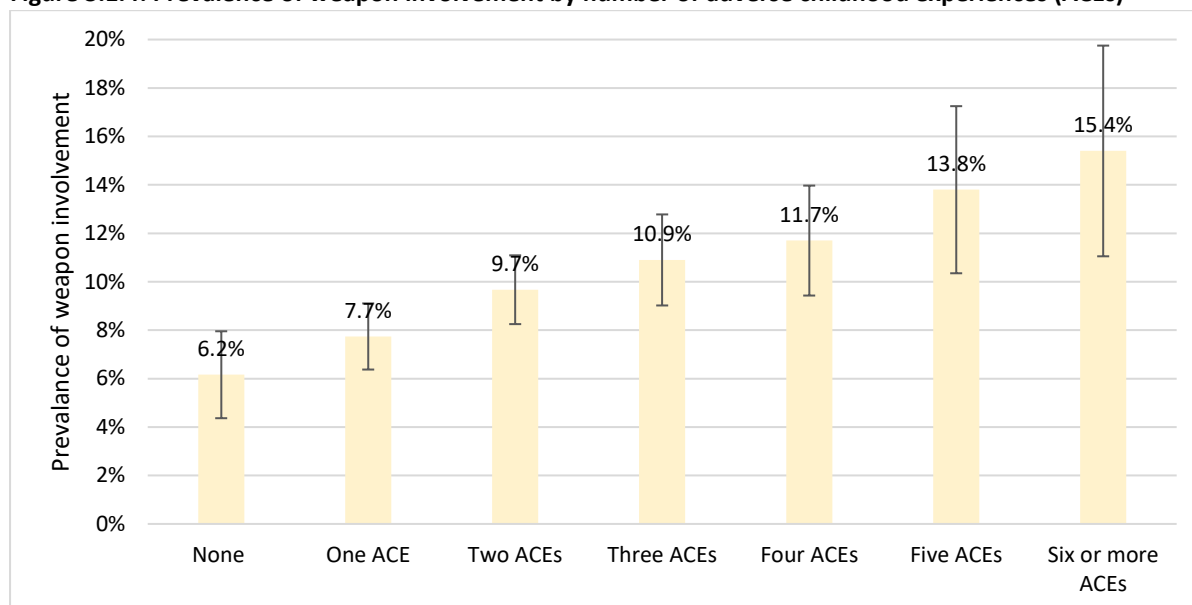
Notes: the model adjusts for sex at birth, ethnicity, maternal age at birth, income, education, occupational status and the number of sweeps the parent was single. Capped lines indicate 95% confidence intervals. Sample size N=14,088 (imputed sample). Results weighted for survey design.

Table 3.1.6: Prevalence of weapon involvement by number of adverse childhood experiences (ACEs) and associated risk ratios (RR)

	Prevalence	RR
ACEs		
None	6.2%	Ref
One ACE	7.7%	1.26+
Two ACEs	9.7%	1.57**
Three ACEs	10.9%	1.77***
Four ACEs	11.7%	1.90***
Five ACEs	13.8%	2.24***
Six or more ACEs	15.4%	2.50***

Notes: model adjusts for sex at birth, ethnicity, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single and PCEs. Gender differences were examined in an interaction model. *** $p<0.001$, ** $p<0.01$, * $p<0.05$, + $p<0.10$. Sample size N=14,088 (imputed sample). Results weighted for survey design.

Examination by gender

Figure 3.1.5 and Table 3.1.7 report the association between the number of ACEs and weapon involvement for males and females. It is noticeable that the gradient is relatively flat for females at the lower end of ACEs and becomes steeper as ACEs increase, but for males, there is a noticeable increase even at the lower end of ACEs. Looking at the risk ratios, for males, these are quite high for just having one or two ACEs, whereas for females, risk ratios only become large at the higher end of ACEs, where they are larger than for males. This might suggest that males are more sensitive to even low levels of ACEs when it comes to weapon

involvement. However, none of these gender differences were significant statistically, so care should be taken with these interpretations.

Figure 3.1.5: Prevalence of weapon involvement by number of adverse childhood experiences (ACEs) (males vs females)
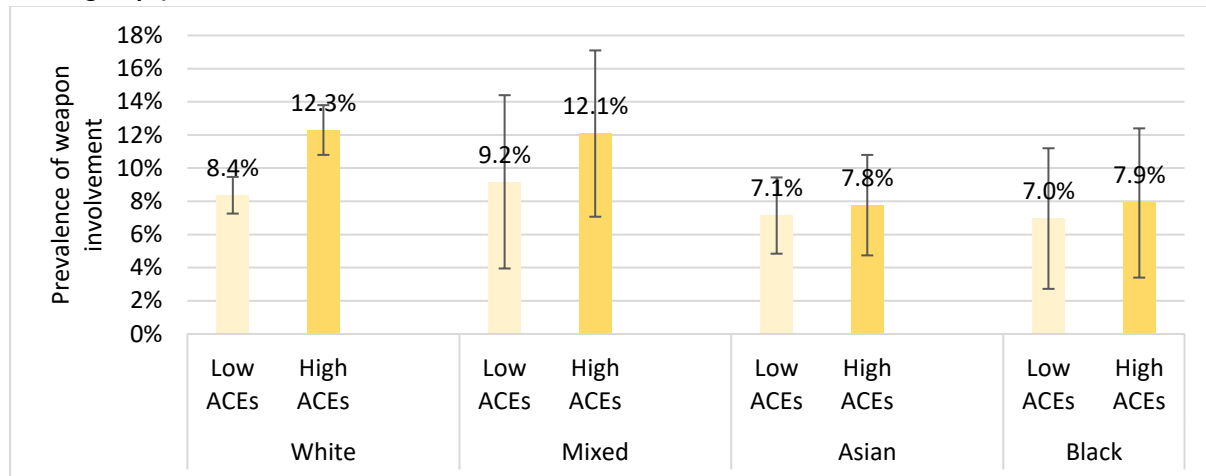

Notes: models adjust for ethnicity, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single and PCEs. Capped lines indicate 95% confidence intervals. Sample size N=14,088 (imputed sample). Males N=7,241, females N=6,847. Results weighted for survey design.

Table 3.1.7: Prevalence of weapon involvement by number of adverse childhood experiences (ACEs) and associated risk ratios (RR) (males vs females)

	Males		Females		Gender difference (males)
	Prevalence	RR	Prevalence	RR	RR
ACEs					
None	8.4%	Ref	3.5%	Ref	Ref
One ACE	11.1%	1.32+	3.7%	1.07	1.21
Two ACEs	14.1%	1.68**	4.5%	1.29	1.26
Three ACEs	15.3%	1.82**	5.8%	1.67	1.05
Four ACEs	16.9%	2.01***	5.7%	1.65	1.17
Five ACEs	18.9%	2.25***	8.0%	2.29*	0.93
Six or more ACEs	20.7%	2.46***	9.5%	2.74*	0.84

Notes: models adjust for ethnicity, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single and PCEs. Gender differences were examined in an interaction model. *** $p<0.001$, ** $p<0.01$, * $p<0.05$, + $p<0.10$. Sample size N=14,088 (imputed sample). Males N=7,241, females N=6,847. Results weighted for survey design.

Examination by ethnicity

Figure 3.1.6 and Table 3.1.8 examine ethnicity by looking at the Asian, Black, Mixed and White ethnic groups. ACEs were reduced to binary measures (high vs low), as it was not possible to meaningfully examine the expanded version of this measure alongside multiple ethnic groups.

These reveal a lower association between ACEs and weapon involvement in ethnic minority groups, mostly so in Asian and Black ethnic groups, and less so by those of Mixed ethnic backgrounds. However, it is important to highlight that these ethnic differences do not meet the threshold for statistical significance, so care should be taken when interpreting these results.

Figure 3.1.6: Prevalence of weapon involvement by high vs low adverse childhood experiences (ACEs) (by ethnic groups)

Note: the Other ethnicity category had very small numbers (N=76), so to enable analyses to run and converge, this had to be dropped from the analyses. Models adjust for gender, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single and PCEs. Capped lines indicate 95% confidence intervals. Sample size N=14,012 (imputed sample). Asian N=902, Black N=358, Mixed N=454, White N=12,299. Results weighted for survey design.

Table 3.1.8: Prevalence of weapon involvement by high vs low adverse childhood experiences (ACEs) and associated risk ratios (RR) (by ethnic groups)

	Low ACEs (zero to two)	High ACEs (three+)	High vs low ACEs	Ethnic difference
	Prevalence	Prevalence	RR	RR
White	8.4%	12.3%	1.47***	Ref
Mixed	9.2%	12.1%	1.32	0.90
Asian	7.1%	7.8%	1.09	0.74
Black	7.0%	7.9%	1.13	0.77

Note: the Other ethnicity group had very small numbers (N=76), so to enable analyses to run and converge, this had to be dropped from the analyses. Models adjust for gender, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single and PCEs. Ethnic differences were examined in an interaction model. *** p<0.001, ** p<0.01, * p<0.05, + p<0.10. Sample size N=14,012 (imputed sample). Asian N=902, Black N=358, Mixed N=454, White N=12,299. Results weighted for survey design.

Association between adverse childhood experiences and gang involvement

Table 3.1.9 shows the results of examining each single ACE in relation to gang involvement, adjusting for covariates. The strongest association was for parental drug use (RR=1.50, p<0.001), which is a 50% increase in risk, followed by single parent, associated with a 43% increase (RR=1.43, p<0.05), and domestic violence, associated with a 34% increase (RR=1.34,

p<0.01). The weakest association was for poor parental relationship, parental mental health and parental breakup, with none of these being significant.

The associations between the total number of ACEs and the risk of gang involvement are presented in Figure 3.1.7 and Table 3.1.10. A higher number of ACEs was associated with a higher risk. Those with six or more ACEs had a prevalence of 10.6% compared to 4.2% for those with no ACEs, which means that the former is around 2.5 times more likely to experience gang involvement in adolescence (RR=2.54, p<0.001), which is an increased risk of 154%.

Table 3.1.9: Risk of gang involvement for single adverse childhood experiences (ACEs)

Model		RR
M1	Single parent	1.43*
M2	Parental breakup	1.17
M3	Domestic violence	1.34**
M4	Verbal abuse	1.25
M5	Physical abuse	1.25
M6	Parental alcohol abuse	1.24*
M7	Parental drug use	1.50***
M8	Parental mental health	1.11
M9	Poor parental relationship	1.01
M10	Poor parent–child relationship	1.20
M11	Parental long-term disability/illness	1.18

Notes: each ACE is examined in a separate logistic regression model. The models adjust for sex at birth, ethnicity, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single and PCEs. *** p<0.001, ** p<0.01, * p<0.05, + p<0.10. Sample size N=14,088 (imputed sample). Results weighted for survey design. RR=risk ratio

Figure 3.1.7: Prevalence of gang involvement by number of adverse childhood experiences (ACEs)
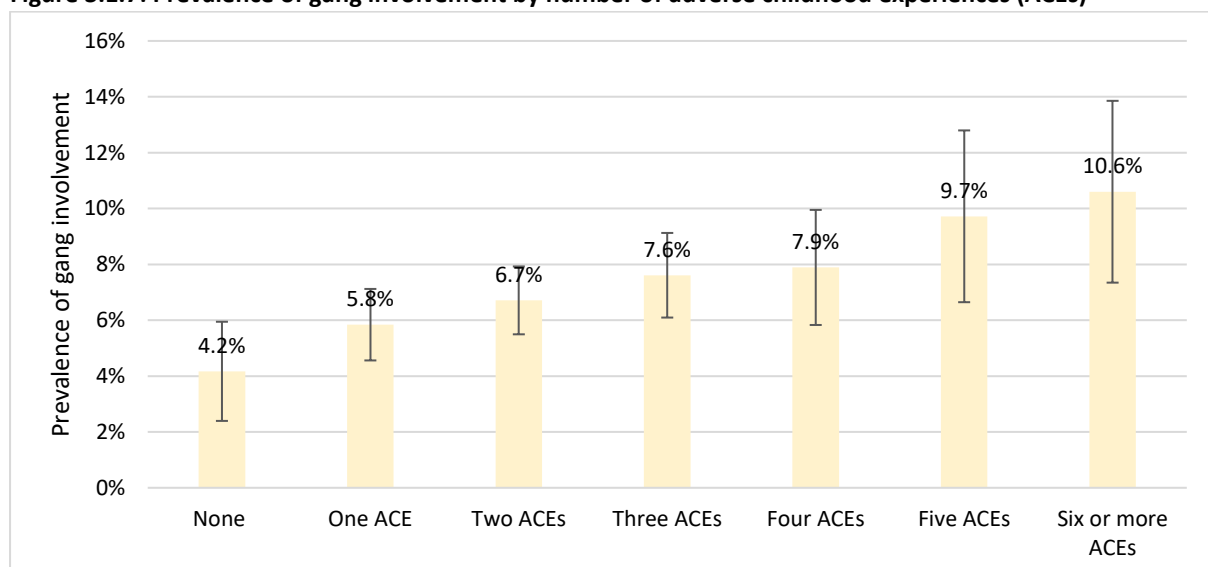
Notes: prevalences are marginal effects from logistic regression analysis. The models adjust for sex at birth, ethnicity, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single and PCEs. Capped lines indicate 95% confidence intervals. Sample size N=14,088 (imputed sample). Results weighted for survey design.

Table 3.1.10: Prevalence of gang involvement by number of adverse childhood experiences (ACEs) and associated risk ratios (RR)

	Prevalence	RR
ACEs		
None	4.2%	Ref
One ACE	5.8%	1.40
Two ACEs	6.7%	1.61*
Three ACEs	7.6%	1.82**
Four ACEs	7.9%	1.89**
Five ACEs	9.7%	2.33**
Six or more ACEs	10.6%	2.54***

Notes: models adjust for sex at birth, ethnicity, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single and PCEs. Gender differences were examined in an interaction model. *** p<0.001, ** p<0.01, * p<0.05, + p<0.10. Sample size N=14,088 (imputed sample). Results weighted for survey design.

Examination by gender

Figure 3.1.8 and Table 3.1.11 show the association between the number of ACEs and gang involvement for males and females. We see that for lower levels of ACEs the association is weaker for males than for females, but for higher levels of ACEs it is stronger for males, except for those with six or more ACEs, where females have an increased risk of gang involvement of 74% vs 44% for males. However, none of these gender differences were statistically significant (see the last column in Table 3.1.13). Statistical power for detecting effects could be low due to the low prevalence of gang involvement and further examination by gender groups.

Figure 3.1.8: Prevalence of gang involvement by number of adverse childhood experiences (ACEs) (males vs females)
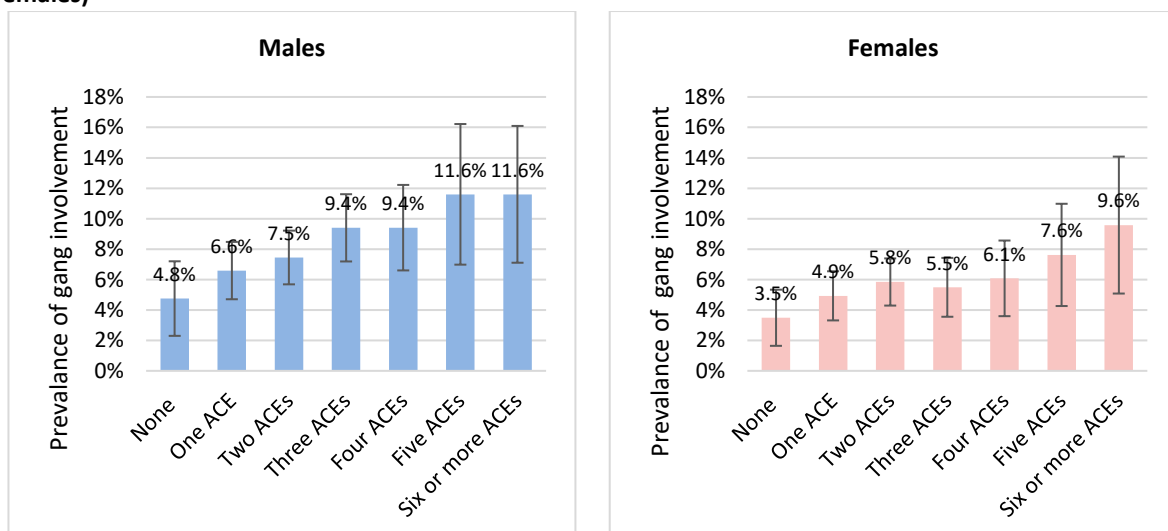
Notes: models adjust for ethnicity, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single and PCEs. Capped lines indicate 95% confidence intervals. Sample size N=14,088 (imputed sample). Males N=7,241, females N=6,847. Results weighted for survey design.

Table 3.1.11: Prevalence of weapon involvement by number of adverse childhood experiences (ACEs) and associated risk ratios (RR) (males vs females)
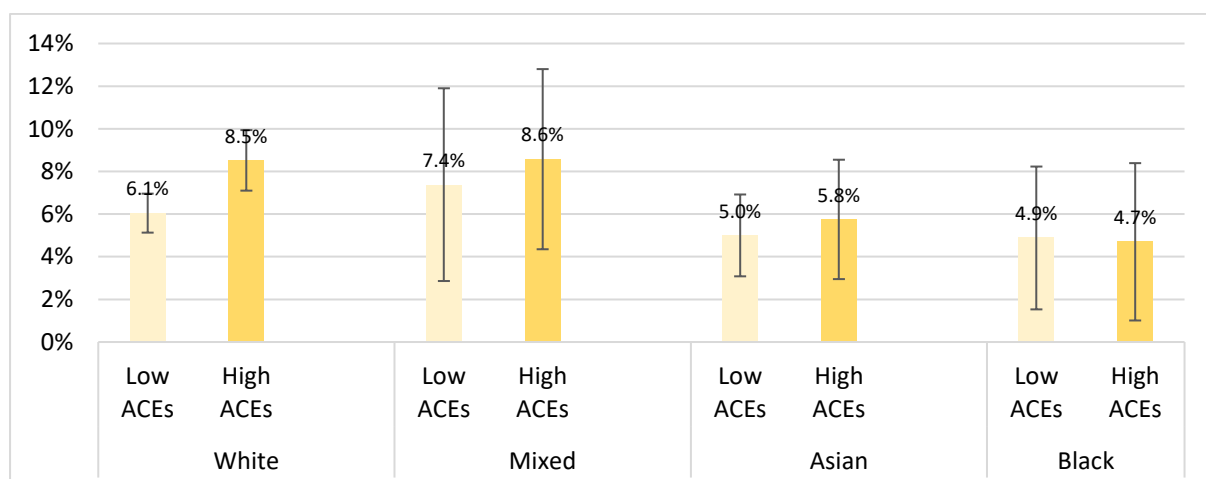
	Males		Females		Gender difference (males)
	Prevalence	RR	Prevalence	RR	RR
ACEs					
None	4.8%	Ref	3.5%	Ref	Ref
One ACE	6.6%	1.39	4.9%	1.41	0.97
Two ACEs	7.5%	1.57+	5.8%	1.67	0.92
Three ACEs	9.4%	1.98*	5.5%	1.57	1.24
Four ACEs	9.4%	1.98*	6.1%	1.74	1.12
Five ACEs	11.6%	2.44**	7.6%	2.18+	1.08
Six or more ACEs	11.6%	2.44**	9.6%	2.74*	0.87

Notes: models adjust for ethnicity, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single and PCEs. Gender differences were examined in an interaction model. *** $p<0.001$, ** $p<0.01$, * $p<0.05$, + $p<0.10$. Sample size N=14,088 (imputed sample). Males N=7,241, females N=6,847. Results weighted for survey design.

Examination by ethnicity

Figure 3.1.9 and Table 3.1.12 show examinations of the Asian, Black, Mixed, and White ethnic groups using the binary measure of high vs low ACEs in relation to gang involvement. These show weaker associations between ACEs and gang involvement among ethnic minorities, especially for the Black ethnic group, followed by the Asian group, and less so for those of Mixed ethnic background. Again, it must be noted that these ethnic differences are not statistically significant (see the last column of Table 3.1.12), although lack of statistical power is likely a factor in these examinations.

Figure 3.1.9: Prevalence of gang involvement by high vs low adverse childhood experiences (ACEs) (by ethnic groups)

Notes: the Other ethnicity category had very small numbers (N=76), so to enable analyses to run and converge, this had to be dropped from the analyses. Models adjust for gender, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single and PCEs. Capped lines indicate 95% confidence intervals. Sample size N=14,012 (imputed sample). Asian N=902, Black N=358, Mixed N=454, White N=12,299. Results weighted for survey design.

Table 3.1.12: Prevalence of gang involvement by high vs low adverse childhood experiences (ACEs) and associated risk ratios (RR) (by ethnic groups)

	Low ACEs (0–2) Prevalence	High ACEs (3+) Prevalence	High vs Low ACEs RR	Ethnic differences RR
White	6.1%	8.5%	1.41**	Ref
Mixed	7.4%	8.6%	1.17	0.83
Asian	5.0%	5.8%	1.15	0.82
Black	5.1%	4.8%	0.96	0.68

Notes: the Other ethnicity group had very small numbers (N=76), so to enable analyses to run and converge, this had to be dropped from analyses. Models adjust for gender, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single and PCEs. Ethnic differences were examined in an interaction model. *** p<0.001, ** p<0.01, * p<0.05, + p<0.10. Sample size N=14,012 (imputed sample).Asian N=902, Black N=358, Mixed N=454, White N=12,299. Results weighted for survey design.

Additional analyses

Robustness checks

Additional analyses were carried out, which are reported in the Appendix. These examine the association between ACEs and youth violence outcomes with additional control variables included as a robustness check. This was done to address the concern that the ACEs that a child experiences in its childhood family environment could be influenced by the child's own behaviours. Therefore, child conduct problems reported by parents at age 3 are added as a potential covariate. Also included in these models are neighbourhood violent crime and general neighbourhood deprivation, which factor out any confounding effect of the neighbourhood in the association between ACEs and youth violence. Results are shown in Table A3.1.1 (see Appendix). For all three youth violence outcomes, we see that despite these additional controls, ACEs still have strong and significant associations with youth violence outcomes, with only a minor reduction in the risk ratios compared to the main results reported above.

Results using non-imputed data

Analyses were carried out using the smaller non-imputed data sample in order to compare results with those from the main results using the fully imputed sample. These are shown in Table A3.1.2. Results are largely similar to the main results, showing that a higher number of ACEs are associated with a higher risk of youth violence when compared with no ACEs. However, there are some differences, as the non-imputed results follow a less linear pattern, with the largest risk ratios not being for the highest level of ACEs. On the other hand, the imputed results showed a much clearer linear pattern, with the risk of youth violence increasing slightly for each higher level of ACEs and with the largest risk being for those with the highest level of ACEs. We also see that the available observations or sample sizes are much lower (assault perpetration N=6,901, weapon involvement N=4,865 and gang involvement N=4,930). This reduces the statistical power of these analyses, as reflected in the many non-significant p-values.

Summary of results for RQ1a: which single and cumulative ACEs are associated with youth violence, and what are the magnitudes of the associations?

Overall, the examinations showed that experiencing a high number of ACEs during childhood was associated with a substantial and significant increase in the risk of youth violence later in adolescence. This association was stronger for the more serious types of youth violence, weapon involvement and gang involvement, while it was weaker for assault perpetration, which might be regarded as the least serious of the outcomes and also the most prevalent.

Examinations by gender and ethnicity resulted largely in non-significant differences between groups. Some exceptions were that ACEs were associated with a higher increase in risk of assault perpetration in females, and in those of White ethnicity more than those of Black ethnicity. The increased risk for White participants was also seen for weapon and gang involvement, although this difference from other ethnic groups was not statistically significant.

Results for RQ1b: which specific combinations of adverse childhood experiences are most strongly associated with youth violence?

The following will present an examination of which specific combinations of ACEs are most strongly associated with youth violence. This evidence gap in relation to which clusters of ACEs pose the most risk was highlighted by the comprehensive report on ACEs carried out by Asmussen et al. (2020). The approach taken here was to reduce the ACE measure to only five items, drawing on different combinations of the 11 items in the main measure used in our previous analyses. All possible combinations of five ACEs (399 in total) are then examined in relation to youth violence, controlling for the same set of confounders as in our main analyses. For easier comparison across the many combinations of ACEs, a single risk ratio estimate is presented that focuses on the comparison between those with three or more ACEs vs no ACEs. This threshold was used as there are only five single ACEs in each combination, so a cut-off of three and above was a sensible solution, as four and above had a very low prevalence (<2%) vs three and above at 9%. Standard errors would have been too large, and drawing out any difference between the combinations would have been more difficult.

Adverse childhood experience combinations and assault perpetration

Figure 3.1.10 shows the results for all possible combinations of ACEs and their associations with assault perpetration. Risk ratios are ordered from highest (associated with the highest risk of assault perpetration) to lowest (associated with the lowest risk) and are represented by the red line. In grey are the confidence intervals. We see overlapping confidence intervals between the highest risk ratio (RR=1.40, 95% CI:1.25–1.56) and the lowest (RR=1.10, 95% CI:0.96–1.24), indicating that these differences are not statistically significant.

Table A3.1.3 (see Appendix) shows the 10 ACE combinations associated with the highest risk of assault perpetration and the 10 combinations associated with the lowest risk, where the single ACEs making up the measures have been listed. This shows that the combination of ACEs associated with the highest risk of assault perpetration is parental drug use, single parent, domestic violence, parental disability/illness and physical abuse. The ACE combination associated with the lowest risk is poor parent–child relationship, parental breakup, parental mental health, physical abuse and single parent. The inclusion of single parent in both is likely to be because that ACE had the highest prevalence out of all ACEs. It should also be highlighted that the ACE combinations associated with the highest risk have a statistically significant association with assault perpetration, whereas many of the associations for the lowest risk combinations are not statistically significant. Although these measures did not prove to be significantly different statistically in their association with assault perpetration, it is noteworthy that those single ACE items associated with the highest risk of assault perpetration tend to also feature most frequently among the 10 highest risk ACE combinations (see Table 3.1.13).

Figure 3.1.10: Associations between different combinations of adverse childhood experiences (ACEs) and assault perpetration
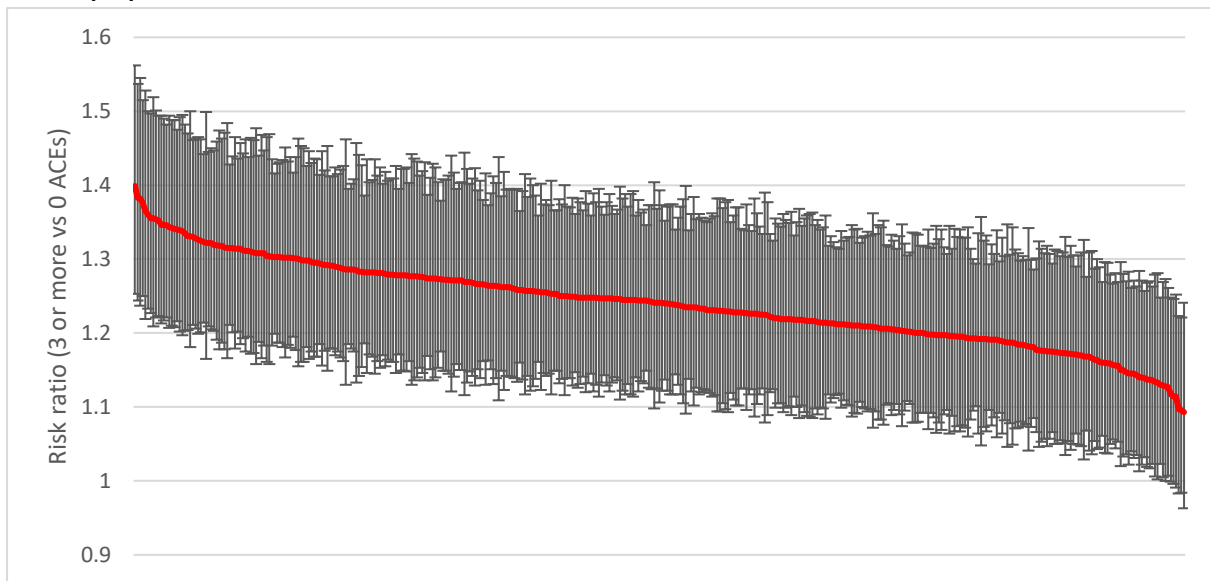
Notes: each combination of five ACEs is examined in its own model. Adjusted for sex at birth, ethnicity, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single and PCEs.
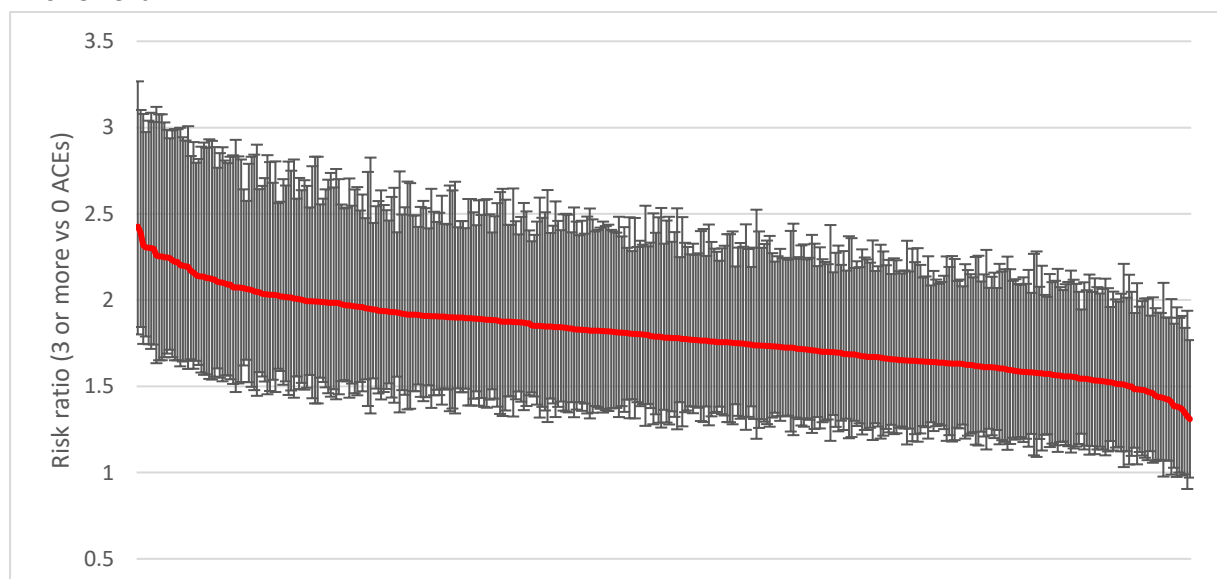Sample size N=14,088 (imputed sample). Results weighted for survey design.

Table 3.1.13: Single adverse childhood experiences (ACEs), their associations with assault perpetration and their frequency in cumulative ACE measures with the highest and lowest risk ratio (RR) association with assault perpetration

Single ACE domain	Association with assault perpetration (RR)	Number of times in ACEs with the 10 highest RR associations with assault perpetration	Number of times in ACEs with the 10 lowest RR associations with assault perpetration
Single parent	1.17**	10	6
Parental drug use	1.16**	9	0
Domestic violence	1.13***	9	0
Parental alcohol abuse	1.13***	5	0
Parental long-term disability/illness	1.11**	8	2
Verbal abuse	1.08*	2	5
Poor parental relationship	1.08*	0	4
Physical abuse	1.05	4	7
Parental mental health	1.03	1	10
Poor parent–child relationship	1.02	1	9
Parental breakup	1.04	1	7

Notes: adjusted for sex at birth, ethnicity, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single and PCEs. Sample size N=14,088 (imputed sample). Results weighted for survey design.

Adverse childhood experience combinations and weapon involvement

Figure 3.1.11 shows the results for all possible combinations of ACEs and their associations with weapon involvement. Estimates are ordered from the highest risk ratios (associated with the highest risk of weapon involvement) to the lowest (associated with the lowest risk), represented by the red line. In grey are confidence intervals. Results show that confidence

intervals between the highest risk ratio (RR=2.43, 95% CI:1.80–3.27) and the lowest (RR=1.31, 95% CI:0.97–1.80) are overlapping, suggesting that these differences are not statistically significant.

Table A3.1.4 (see Appendix) shows the 10 ACE combinations associated with the highest risk of weapon involvement and the 10 combinations associated with the lowest risk, where the single ACEs making up the measures have been listed. The combination of ACEs that is associated with the highest risk of weapon involvement is parental drug use, single parent, domestic violence, parental disability/illness and physical abuse. The ACE combination associated with the lowest risk is poor parental relationship, poor parent–child relationship, parental breakup, parental mental health and verbal abuse. In addition, the association with weapon involvement for the riskiest ACEs is statistically significant, whereas many of the lower risk combinations do not have a significant association with this youth violence outcome. Although these measures were not significantly different statistically in their association with weapon involvement, it is noteworthy that those single ACE items associated with the highest risk of weapon involvement tended to be the items that feature most frequently among the 10 highest risk ACE combinations (see Table 3.1.14).

Figure 3.1.11: Associations between different combinations of adverse childhood experiences and weapon involvement

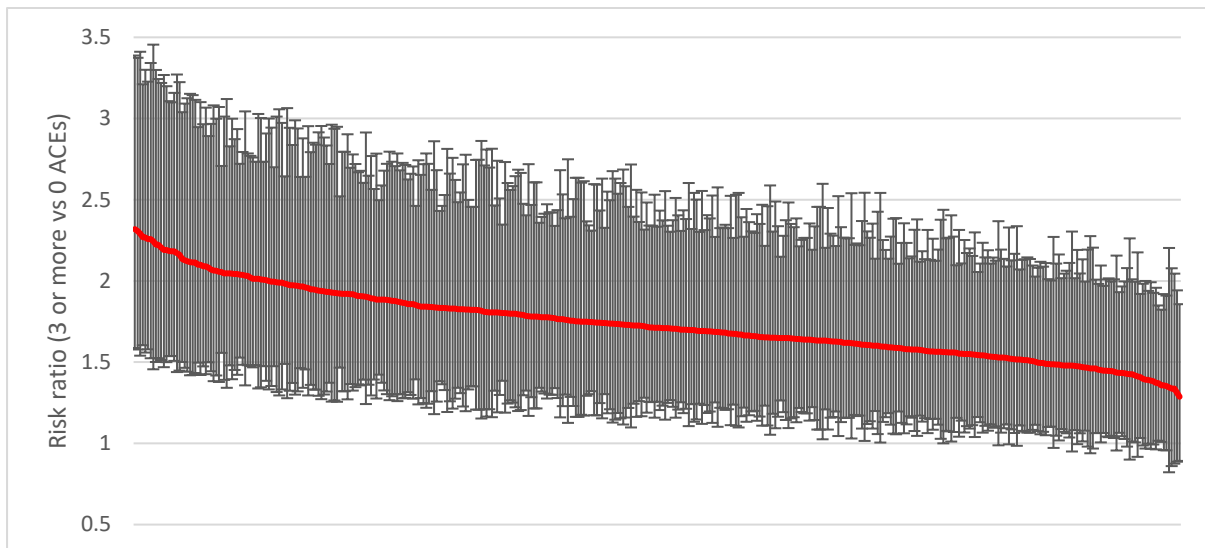Notes: each combination of five ACEs is examined in its own model. Adjusted for sex at birth, ethnicity, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single and PCEs.
Sample size N=14,088 (imputed sample). Results weighted for survey design.

Table 3.1.14: Single adverse childhood experiences (ACEs), their association with weapon involvement and their frequency in cumulative ACE measures with the highest and lowest risk ratio (RR) association with weapon involvement

Single ACEs domain	Association with weapons involvement (RR)	Number of times in ACEs with the 10 highest RR associations with weapon involvement	Number of times in ACEs with the 10 lowest RR associations with weapon involvement
Parental drug use	1.51***	10	0
Single parent	1.38*	10	4
Domestic violence	1.35***	3	0
Parental alcohol abuse	1.35**	7	1
Parental long-term disability/illness	1.31**	8	2
Parental mental health	1.21+	3	7
Physical abuse	1.20	6	7
Parental breakup	1.13	2	6
Poor parental relationship	1.13	0	8
Verbal abuse	1.11	1	7
Poor parent–child relationship	1.03	0	8

Notes: adjusted for sex at birth, ethnicity, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single and PCEs. Sample size N=14,088 (imputed sample). Results weighted for survey design.

Adverse childhood experience combinations and gang involvement

Figure 3.1.12 show the results for all possible combinations of ACEs and their associations with gang involvement. Risk ratios are ordered from highest (associated with the highest risk of gang involvement) to lowest (associated with the lowest risk), represented by the red line. In grey are the confidence intervals. Results show that confidence intervals between the highest risk ratio (RR=2.32, 95% CI:1.59–3.39) and the lowest (RR=1.29, 95% CI:0.89–1.86) are overlapping, suggesting that these differences are not statistically significant.

Table A3.1.5 (see Appendix) presents the 10 highest risk ACE combinations and the 10 lowest risk combinations, where the single ACEs making up the measures have been listed. The combination of ACEs associated with the highest risk of gang involvement is parental drug use, single parenthood, domestic violence, verbal abuse and parental breakup. The ACE combination associated with the lowest risk is poor parental relationship, poor parent–child relationship, parental mental health, physical abuse and parental disability/illness. In addition, the associations with gang involvement for the riskiest ACEs are statistically significant, whereas many of the lower risk combinations do not have a significant association with this youth violence outcome. Although the higher and lower risk measures did not prove to be significantly different statistically in their association with gang involvement, it is interesting that those single ACE items that were most associated with the highest risk of gang involvement are largely those that feature most frequently among the 10 highest risk ACEs combinations (see Table 3.1.15).

Figure 3.1.12: Associations between different combinations of adverse childhood experiences (ACEs) and gang involvement

Notes: each combination of five ACEs is examined in its own model. Adjusted for sex at birth, ethnicity, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single and PCEs. Sample size N=14,088 (imputed sample). Results weighted for survey design.

Table 3.1.15: Single adverse childhood experiences (ACEs), their association with gang involvement and their frequency in cumulative ACE measures with the highest and lowest risk ratio (RR) association with gang involvement

Single ACEs domain	Association with gang involvement (RR)	Number of times in ACEs with the 10 highest RR associations with gang involvement	Number of times in ACEs with the 10 lowest RR associations with gang involvement
Parental drug use	1.50***	10	0
Single parent	1.43*	10	3
Domestic violence	1.34**	6	0
Verbal abuse	1.25	5	1
Physical abuse	1.25	6	6
Parental alcohol abuse	1.24*	1	4
Poor parent–child relationship	1.20	3	6
Parental long-term disability/illness	1.18	5	7
Parental breakup	1.17	5	4
Parental mental health	1.11	0	10
Poor parental relationship	1.01	0	10

Notes: adjusted for sex at birth, ethnicity, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single and PCEs. Sample size N=14,088 (imputed sample). Results weighted for survey design.

Summary of results for RQ1b: which specific combinations of adverse childhood experiences are most strongly associated with youth violence?

Results of examinations showed that the combination of ACEs that was associated with the highest risk of youth violence outcomes was parental drug use, single parenthood, domestic violence, physical abuse and parental disability/illness. These also tended to be the individual

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ACE items that were associated with the highest risk of assault perpetration, weapon involvement or gang involvement.

Positive childhood experiences in relation to youth violence

Results for RQ2a: which single and cumulative positive childhood experiences are associated with youth violence, and what are the magnitudes of the associations?

Association between positive childhood experiences and assault perpetration

Table 3.2.1 shows the associations between single PCEs and assault perpetration, where these are examined in a separate regression model (M1–M7) adjusted for covariates. The strongest association was seen for good school connectedness (RR=0.79, p<0.001), meaning that the risk or prevalence of assault perpetration is reduced by 21%. This is followed by low-risk peers, associated with a 20% reduction (RR= 0.80, p<0.001), and positive peer experiences, associated with an 18% reduction (RR=0.82, p<0.001). The weakest association was for activities and hobbies, associated with a borderline significant reduction of 6% (RR=0.94, p<0.10).

In Figure 3.2.1 and Table 3.2.2, the association between number and PCEs is examined. This shows that the higher the number of PCEs, the lower the risk or prevalence of assault perpetration in adolescence. Specifically, those with six to seven PCEs have a prevalence of 33.0% compared to 50.7% for those with zero to two PCEs, which is a risk ratio of 0.65 (p<0.001) or a 35% reduction in the prevalence of assault perpetration.

Table 3.2.1: Risk of assault perpetration for single positive childhood experiences (PCEs)

Model		RR
M1	Low-risk peers	0.80***
M2	Positive peer experiences	0.82***
M3	Good school connectedness	0.79***
M4	Positive teacher–child relationship	0.87***
M5	Activities and hobbies	0.95+
M6	Safe neighbourhood	0.93**
M7	Feeling safe in the playground	0.91***

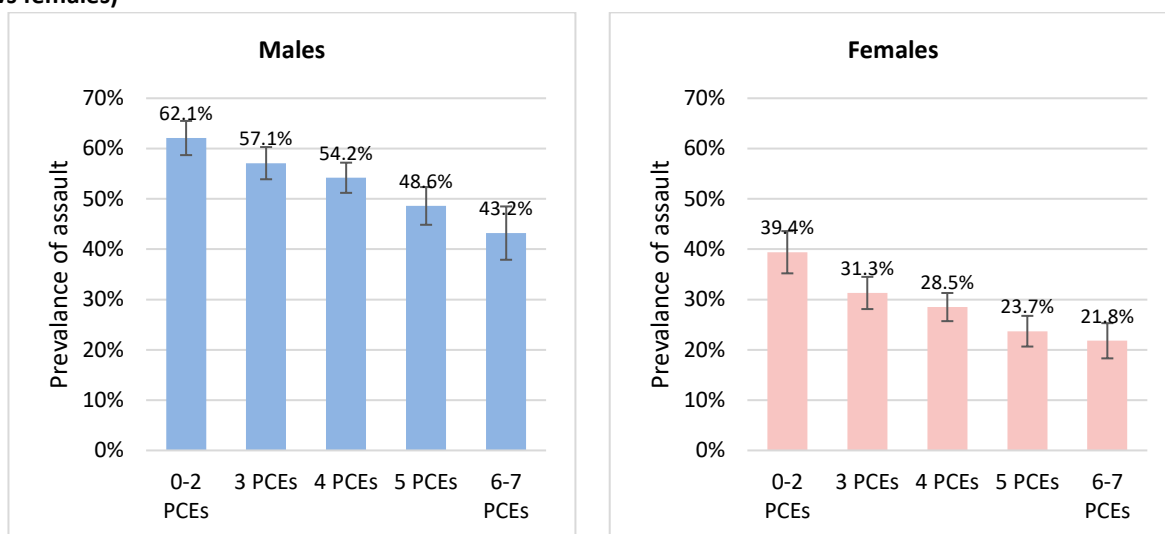Notes: each PCE is examined in a separate logistic regression model. The models adjust for sex at birth, ethnicity, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single and ACEs. *** p<0.001, ** p<0.01, * p<0.05, + p<0.10. Sample size N=14,088 (imputed sample). Results weighted for survey design. RR=risk ratio

Figure 3.2.1: Prevalence of assault perpetration by number of positive childhood experiences (PCEs)
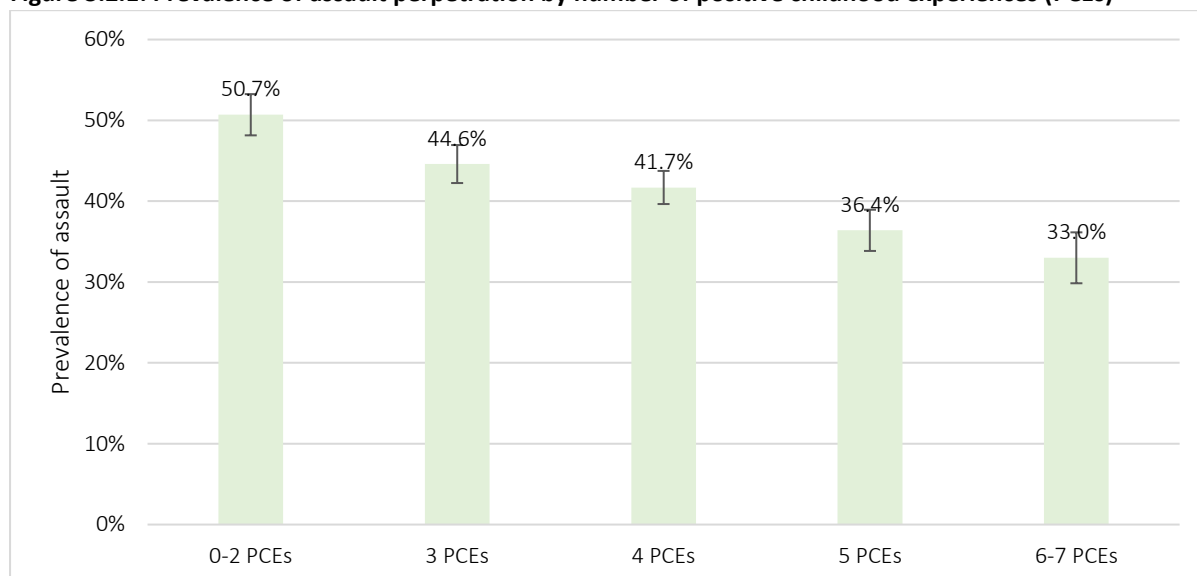
Notes: adjusted for sex at birth, ethnicity, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single and ACEs. Capped lines indicate 95% confidence intervals. Sample size N=14,088 (imputed sample). Results weighted for survey design.

Table 3.2.2: Prevalence of assault perpetration by number of positive childhood experiences (PCEs) and associated risk ratios (RR)

	Prevalence	RR
PCEs		
0–2 PCEs	50.7%	Ref
3 PCEs	44.6%	0.88***
4 PCEs	41.7%	0.82***
5 PCEs	36.4%	0.72***
6–7 PCEs	33.0%	0.65***

Notes: models adjust for sex at birth, ethnicity, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single and adverse childhood experiences. *** $p<0.001$, ** $p<0.01$, * $p<0.05$, + $p<0.10$.
Sample size N=14,088 (imputed sample). Results weighted for survey design.

Examination by gender

Figure 3.2.2 and Table 3.2.3 report the association between PCEs and assault perpetration by gender. These show that the association for females is stronger than for males, meaning that the reduction in assault perpetration is higher for females for every increase in PCEs. For those with six to seven PCEs, the decrease in risk is 45% for females (RR=0.55), compared to 30% for males (RR=0.70). This gender difference is statistically significant, as shown in the last column in Table 3.2.3, with significant gender differences also observed for most lower levels of PCEs.

Figure 3.2.2: Prevalence of assault perpetration by number of positive childhood experiences (PCEs) (males vs females)
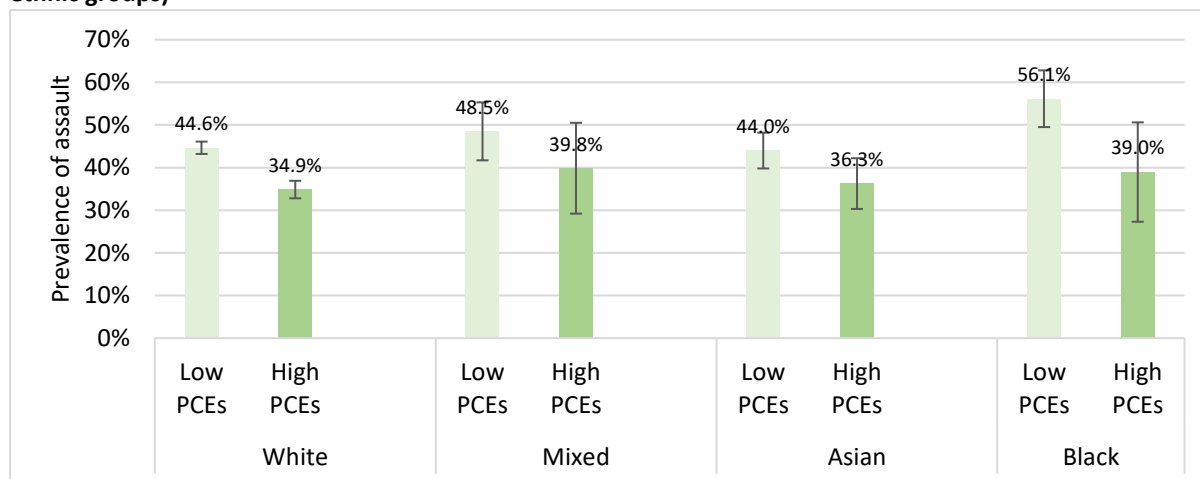

Notes: models adjust for ethnicity, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single and adverse childhood experiences. Capped lines indicate 95% confidence intervals. Sample size N=14,088 (imputed sample). Males N=7,241, females N=6,847. Results weighted for survey design.

Table 3.2.3: Prevalence of assault perpetration by number of positive childhood experiences and associated risk ratios (RR) (males vs females)

	Males		Females		Gender difference (male)
	Prevalence	RR	Prevalence	RR	RR
PCEs					
0–2 PCEs	62.1%	Ref	39.4%	Ref	Ref
3 PCEs	57.1%	0.92*	31.3%	0.79**	1.17+
4 PCEs	54.2%	0.87***	28.5%	0.72***	1.22*
5 PCEs	48.6%	0.78***	23.7%	0.60***	1.33**
6–7 PCEs	43.2%	0.70***	21.8%	0.55***	1.28*

Notes: models adjust for ethnicity, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single and adverse childhood experiences. Gender differences were examined in an interaction model. *** p<0.001, ** p<0.01, * p<0.05, + p<0.10. Sample size N=14,088 (imputed sample). Males N=7,241, females N=6,847. Results weighted for survey design.

Examination by ethnicity

Examination by ethnic groups, where PCEs were reduced to binary measures (high vs low), are provided in Figure 3.2.3 and Table 3.2.4. These indicate that especially those of Black ethnic background may benefit more from having a high level of PCEs, followed by the Asian, Mixed and White groups, although, statistically, this pattern is not significant. It is nevertheless noticeable that those of Black ethnic backgrounds with low PCEs have a very high prevalence of assault perpetration (56.1%) compared to the Asian and White groups (both around 44%), with confidence intervals confirming these ethnic differences. However, we see that the prevalence of assault perpetration for those of Black ethnicity with a high

level of PCEs comes down and closer to those of other ethnic groups with a high level of PCEs (see Figure 3.2.3).

Figure 3.2.3: Prevalence of assault perpetration by high vs low positive childhood experiences (PCEs) (by ethnic groups)

Notes: the Other ethnicity group was a category with very small numbers (N=76), so to enable analyses to run and converge, this had to be dropped from analyses. Models adjust for gender, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single and adverse childhood experiences. Capped lines indicate 95% confidence intervals. Sample size N=14,012 (imputed sample). Asian N=902, Black N=358, Mixed N=454, White N=12,299. Results weighted for survey design.

Table 3.2.4: Prevalence of assault perpetration by high vs low positive childhood experiences and associated risk ratios (RR) (by ethnic groups)

	Low PCEs (0–4) Prevalence	High PCEs (5+) Prevalence	High vs Low PCEs RR	Ethnic differences RR
White	44.6%	34.9%	0.78***	Ref
Mixed	48.5%	39.8%	0.82	1.05
Asian	44.0%	36.3%	0.83*	1.05
Black	56.1%	39.0%	0.70*	0.89

Notes: the Other ethnicity group had very small numbers (N=76), so to enable analyses to run and converge, this had to be dropped from the analyses. Models adjust for gender, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single and adverse childhood experiences. Ethnic differences were examined in an interaction model. *** p<0.001, ** p<0.01, * p<0.05, + p<0.10. Sample size N=14,012 (imputed sample). Asian N=902, Black N=358, Mixed N=454, White N=12,299. Results weighted for survey design.

Association between positive childhood experiences and weapon involvement

Table 3.2.5 shows the results of examining each single PCE in relation to weapon involvement and adjusting for covariates. The strongest association is for low-risk peers (RR=0.50, p<0.001), meaning that the risk or prevalence of assault perpetration is reduced by 50%. This is followed by good school connectedness, associated with a 43% reduction (RR=0.57, p<0.001), and positive teacher–child relationship, also a 43% reduction (RR=0.57, p<0.001). The weakest association was for activities and hobbies, associated with a 16% reduction (RR=0.84, p<0.05).

The association between the total number of PCEs experienced in childhood and weapon involvement is presented in Figure 3.2.4 and Table 3.2.6. This shows that those with a higher number of PCEs have a lower rate of involvement. Those with six to seven PCEs had a prevalence of 5.3% compared to 15.5% for those with zero to two PCEs, which is a reduction of 66% (RR=0.34, p<0.001).

Table 3.2.5: Risk of weapon involvement for single positive childhood experiences (PCEs)

Model		RR
M1	Low-risk peers	0.50***
M2	Positive peer experiences	0.65***
M3	Good school connectedness	0.57***
M4	Positive teacher–child relationship	0.57***
M5	Activities and hobbies	0.84*
M6	Safe neighbourhood	0.82*
M7	Feeling safe in the playground	0.78**

Notes: each PCE is examined in a separate logistic regression model. The models adjust for sex at birth, ethnicity, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single and adverse childhood experiences. *** p<0.001, ** p<0.01, * p<0.05, + p<0.10. Sample size N=14,088 (imputed sample). Results weighted for survey design.

Figure 3.2.4: Prevalence of weapon involvement by number of positive childhood experiences (PCEs)
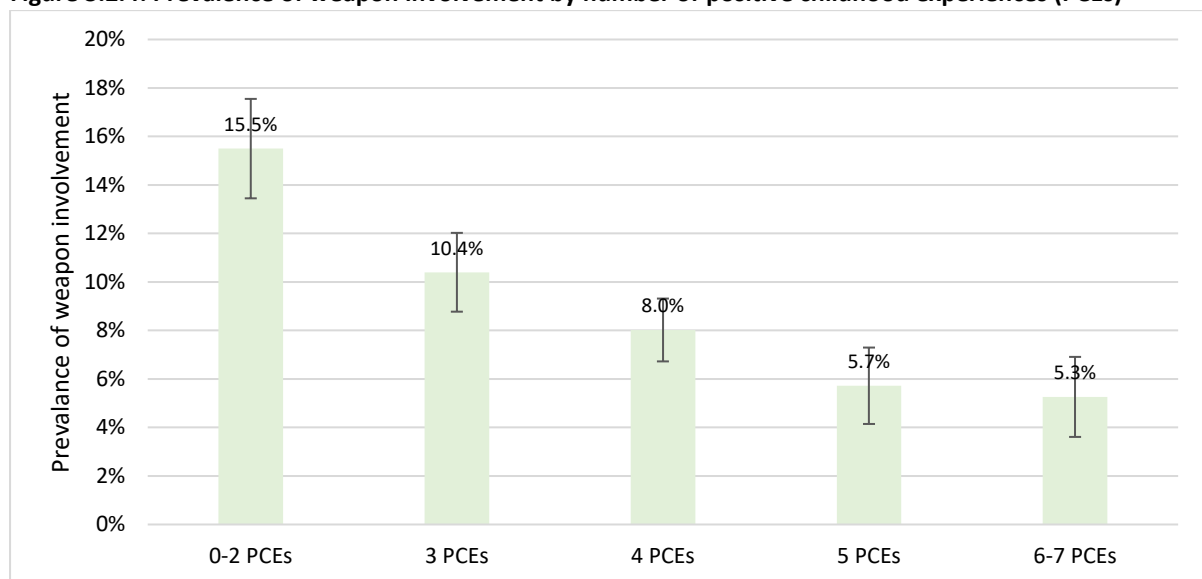
Notes: adjusted for sex at birth, ethnicity, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single and adverse childhood experiences. Capped lines indicate 95% confidence intervals.
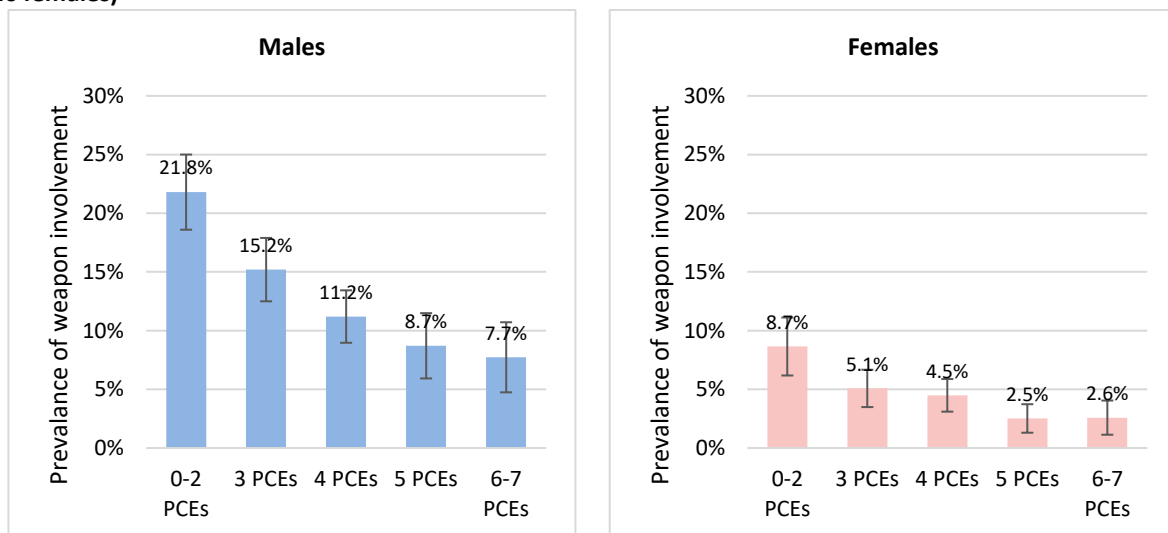Sample size N=14,088 (imputed sample). Results weighted for survey design.

Table 3.2.6: Prevalence of weapon involvement by number of positive childhood experiences (PCEs) and associated risk ratios (RR)

	Prevalence	RR
PCEs		
0–2 PCEs	15.5%	Ref
3 PCEs	10.4%	0.67***
4 PCEs	8.0%	0.52***
5 PCEs	5.7%	0.37***
6–7 PCEs	5.3%	0.34***

Notes: models adjust for sex at birth, ethnicity, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single and adverse childhood experiences.
*** p<0.001, ** p<0.01, * p<0.05, + p<0.10
Sample size N=14,088 (imputed sample). Results weighted for survey design.

Examination by gender

Figure 3.2.5 and Table 3.2.7 show the association between PCEs and weapon involvement by gender. For most levels of PCEs, this indicates a slightly higher protective association females, which can be seen in the lower risk ratios for females for all levels of PCEs. However, statistically, these gender differences are not significant, as shown in the non-significant coefficients in the last column in Table 3.2.7. It is important to point out that lack of statistical power may influence these analyses due to the relatively low overall prevalence of weapon involvement, which is further reduced when examining these by multiple levels of PCEs and by gender.

Figure 3.2.5: Prevalence of weapon involvement by number of positive childhood experiences (PCEs) (males vs females)

Notes: models adjust for ethnicity, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single and adverse childhood experiences. Capped lines indicate 95% confidence intervals. Sample size N=14,088 (imputed sample). Males N=7,241, females N=6,847. Results weighted for survey design.

Table 3.2.7: Prevalence of weapon involvement by number of positive childhood experiences (PCEs) and associated risk ratios (RR) (males vs females)
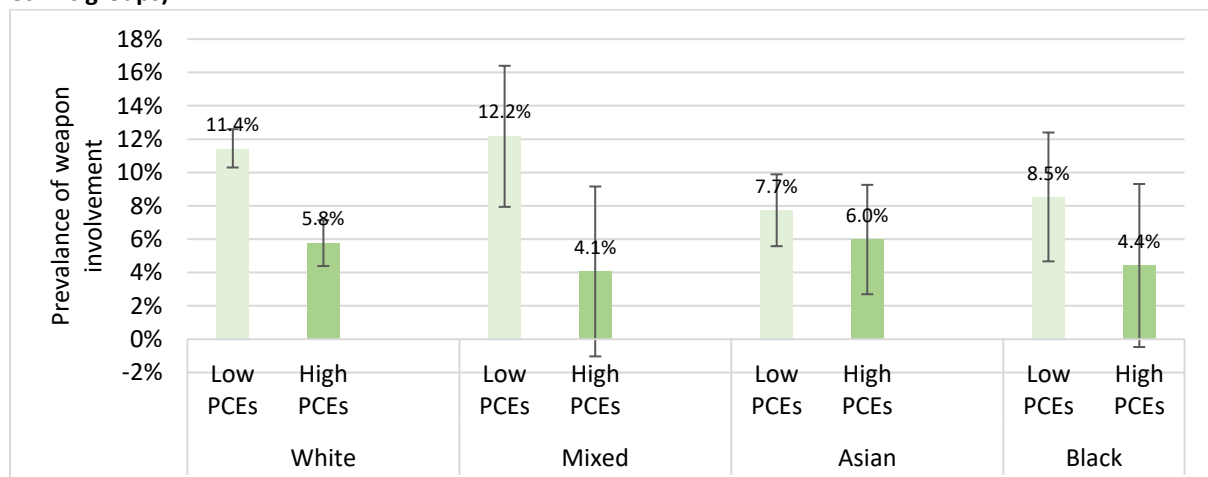
	Males		Females		Gender difference (males)
	Prevalence	RR	Prevalence	RR	RR
PCEs					
0–2 PCEs	21.8%	Ref	8.7%	Ref	Ref
3 PCEs	15.2%	0.70***	5.1%	0.59**	1.19
4 PCEs	11.2%	0.51***	4.5%	0.52***	0.99
5 PCEs	8.7%	0.40***	2.5%	0.29***	1.37
6–7 PCEs	7.7%	0.35***	2.6%	0.30***	1.18

Notes: models adjust for ethnicity, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single and adverse childhood experiences. Gender differences were examined in an interaction model. *** $p<0.001$, ** $p<0.01$, * $p<0.05$, + $p<0.10$. Sample size N=14,088 (imputed sample). Males N=7,241, females N=6,847. Results weighted for survey design.

Examination by ethnicity

The examination of ethnicity looked at the Asian, Black, Mixed and White ethnic groups; PCEs here were reduced to binary measures (high vs low) to make these analyses possible. Results are reported in Figure 3.2.6 and Table 3.2.8. They indicate that those of Mixed ethnic background appear to benefit the most from a high level of PCEs (the lowest risk ratio), followed by those of White ethnicity, then Black ethnicity, and, lastly, those of Asian ethnic background. However, statistically, these ethnic differences are not significant. Lack of statistical power may play a role in the non-significant ethnic differences.

Figure 3.2.6: Prevalence of weapon involvement by high vs low positive childhood experiences (PCEs) (by ethnic groups)

Note: the Other ethnicity group was a category with very small numbers (N=76), so to enable analyses to run and converge, this had to be dropped from analyses. Models adjust for gender, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single and adverse childhood experiences. Capped lines indicate 95% confidence intervals. Sample size N=14,012 (imputed sample). Asian N=902, Black N=358, Mixed N=454, White N=12,299. Results weighted for survey design.

Table 3.2.8: Prevalence of weapon involvement by high vs low positive childhood experiences (PCEs) and associated risk ratios (RR) (by ethnic groups)

	Low PCEs (0–4) Prevalence	High PCEs (5+) Prevalence	High vs Low PCEs RR	Ethnic differences RR
White	11.4%	5.8%	0.51***	Ref
Mixed	12.2%	4.1%	0.33	0.66
Asian	7.7%	6.0%	0.77	1.53
Black	8.5%	4.4%	0.52	1.03

Note: the Other ethnicity group had very small numbers (N=76), so to enable analyses to run and converge, this had to be dropped from analyses. Models adjust for gender, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single and adverse childhood experiences. Ethnic differences were examined in an interaction model. *** p<0.001, ** p<0.01, * p<0.05, + p<0.10. Sample size N=14,012 (imputed sample). Asian N=902, Black N=358, Mixed N=454, White N=12,299. Results weighted for survey design.

Association between positive childhood experiences and gang involvement

Examinations of the association between single PCEs and gang involvement in adolescence are in Table 3.2.9, which reports results from seven separate models. The strongest association was for low-risk peers (RR=0.50, p<0.001), which is a reduction of 50% in the risk of gang involvement. This is followed by school connectedness, associated with a 35% reduction (RR=0.65, p<0.001), positive teacher–child relationship, associated with a 32% reduction (RR=0.68, p<0.001), and positive peer experiences, associated with a 31% reduction (RR=0.69, p<0.01). The weakest was for activities and hobbies and living in a safe neighbourhood, neither of which were significantly associated with gang involvement.

Figure 3.2.7 and Table 3.2.10 show the association between the number of PCEs and gang involvement, showing a protective association of having a high number of PCEs. Those with six to seven PCEs had a prevalence of 4.2% compared to 10.1% for those with zero to two PCEs, which is a reduction of 59% (RR=0.41, p<0.001).

Table 3.2.9: Risk of gang involvement for single positive childhood experiences (PCEs)

Model		RR adjusted
M1	Low-risk peers	0.50***
M2	Positive peer experiences	0.69**
M3	Good school connectedness	0.65***
M4	Positive teacher–child relationship	0.68***
M5	Activities and hobbies	0.91
M6	Safe neighbourhood	0.91
M7	Feeling safe in the playground	0.81*

Notes: each PCE is examined in a separate logistic regression model. The models adjust for sex at birth, ethnicity, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single and adverse childhood experiences. *** p<0.001, ** p<0.01, * p<0.05, + p<0.10. Sample size N=14,088 (imputed sample). Results weighted for survey design. RR=risk ratio

Figure 3.2.7: Prevalence of gang involvement by number of positive childhood experiences (PCEs)
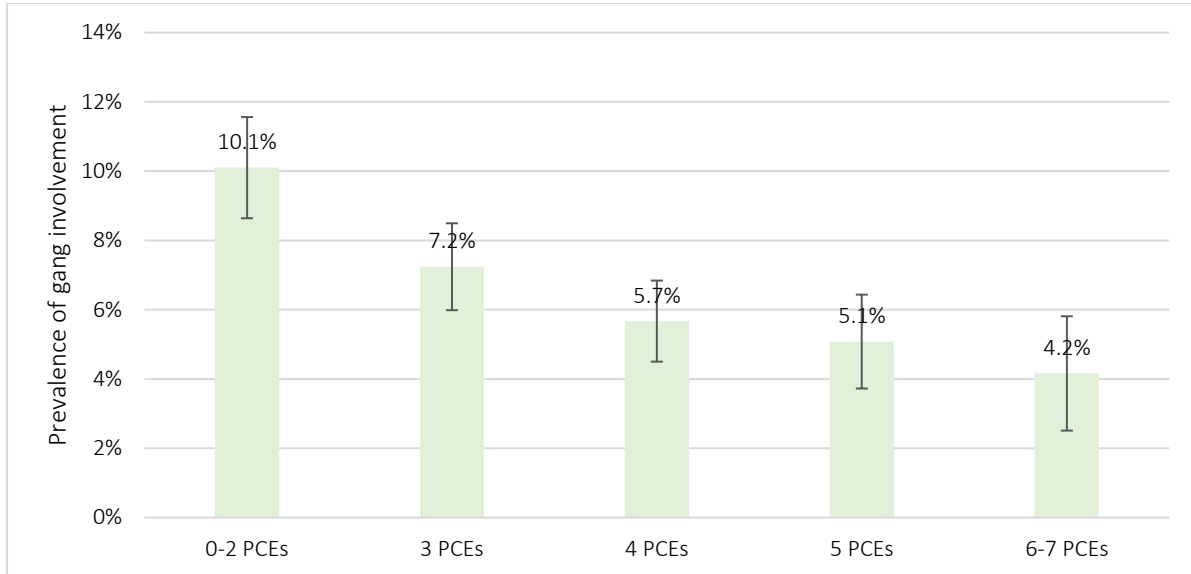
Notes: adjusted for sex at birth, ethnicity, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single and adverse childhood experiences. Capped lines indicate 95% confidence intervals.
Sample size N=14,088 (imputed sample). Results weighted for survey design.

Table 3.2.10: Prevalence of gang involvement by number of positive childhood experiences (PCEs) and associated risk ratios (RR)

	Prevalence	RR
PCEs		
0–2 PCEs	10.1%	Ref
3 PCEs	7.2%	0.72**
4 PCEs	5.7%	0.56***
5 PCEs	5.1%	0.50***
6–7 PCEs	4.2%	0.41***

Notes: model adjusts for sex at birth, ethnicity, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single and adverse childhood experiences.
*** p<0.001, ** p<0.01, * p<0.05, + p<0.10
Sample size N=14,088 (imputed sample). Results weighted for survey design.

Examination by gender

Figure 3.2.8 and Table 3.2.11 show the prevalence of gang involvement by the number of PCEs for males and females. For most levels of PCEs, the risk ratios are slightly lower for males, suggesting stronger protection by PCEs than for females. This is with the exception of those with the highest level of PCEs (six to seven PCEs), where females benefit marginally more than males. These gender differences are, however, not statistically significant.

Figure 3.2.8: Prevalence of gang involvement by number of positive childhood experiences (PCEs) (males vs females)
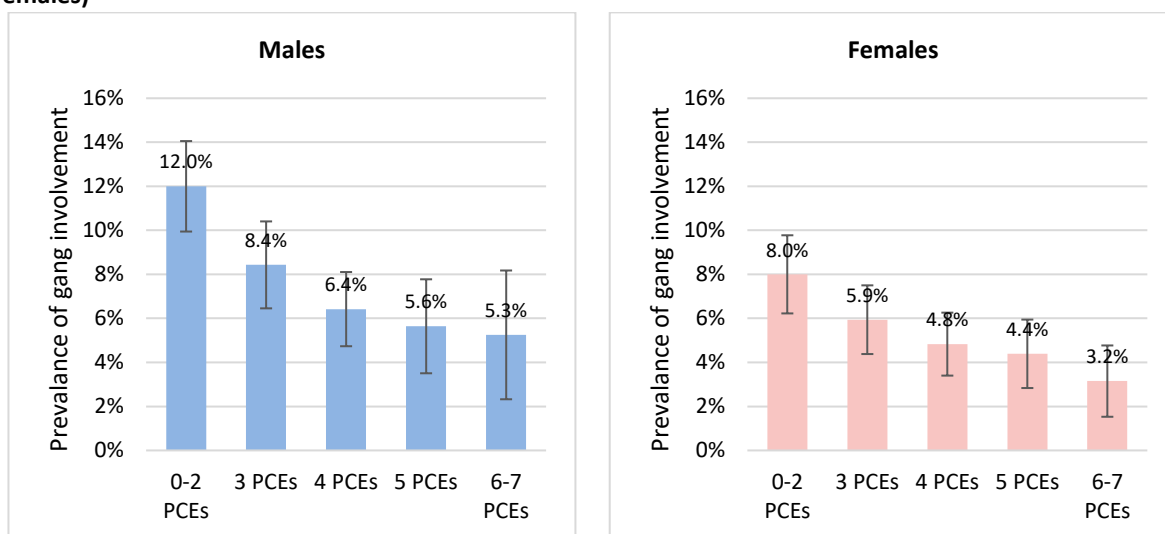
Notes: models adjust for ethnicity, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single and adverse childhood experiences. Capped lines indicate 95% confidence intervals. Sample size N=14,088 (imputed sample). Males N=7,241, females N=6,847. Results weighted for survey design.

Table 3.2.11: Prevalence of gang involvement by number of positive childhood experiences (PCEs) and associated risk ratios (RR) (males vs females)

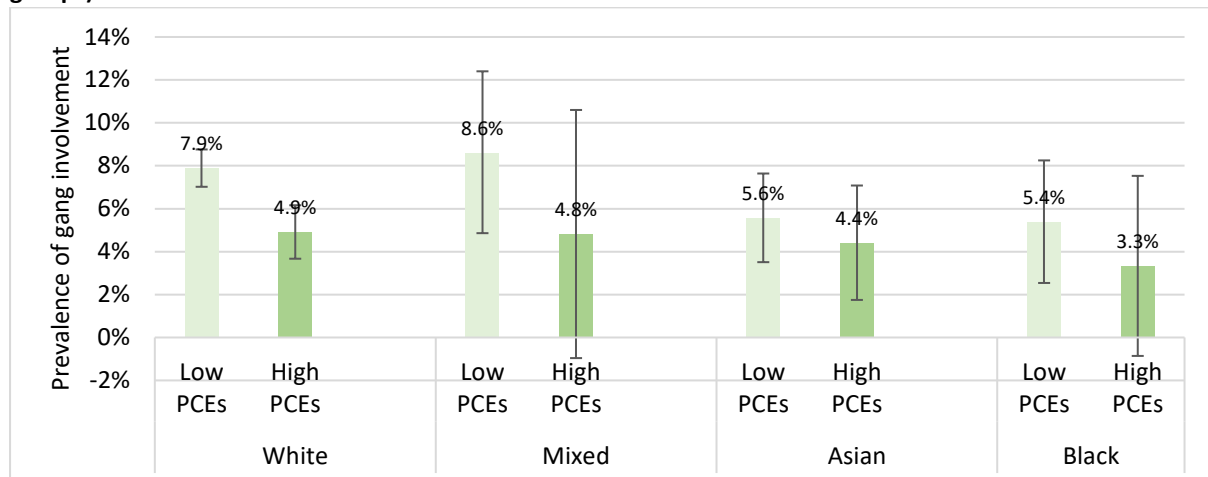|	Males		Females		Gender difference (males)
	Prevalence	RR	Prevalence	RR	RR
PCEs					
0–2 PCEs	12.0%	Ref	8.0%	Ref	Ref
3 PCEs	8.4%	0.70*	5.9%	0.74+	0.96
4 PCEs	6.4%	0.54***	4.8%	0.60**	0.91
5 PCEs	5.6%	0.47***	4.4%	0.55**	0.87
6–7 PCEs	5.3%	0.44**	3.2%	0.39***	1.13

Notes: models adjust for ethnicity, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single and adverse childhood experiences. Gender differences were examined in an interaction model. *** p<0.001, ** p<0.01, * p<0.05, + p<0.10.
Sample size N=14,088 (imputed sample). Males N=7,241, females N=6,847. Results weighted for survey design.

Examination by ethnicity

Examination of ethnic differences in the association between PCEs and gang involvement are reported in Figure 3.2.9 and Table 3.2.12. The group that benefitted the most (lowest risk ratio) are those of Mixed background, followed by the White, Black and then Asian groups. We note that these ethnic differences are not significant statistically, likely influenced by a lack of statistical power. It is worth noting that the same ethnic ordering was seen for weapon involvement.

Figure 3.2.9: Prevalence of gang involvement by high vs low positive childhood experiences (PCEs) (by ethnic groups)

Note: the Other ethnicity group was a category with very small numbers (N=76), so to enable analyses to run and converge, this had to be dropped from the analyses. Models adjust for gender, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single and adverse childhood experiences. Capped lines indicate 95% confidence intervals. Sample size N=14,012 (imputed sample). Asian N=902, Black N=358, Mixed N=454, White N=12,299. Results weighted for survey design.

Table 3.2.12: Prevalence of gang involvement by high vs low positive childhood experiences (PCEs) and associated risk ratios (RR) (by ethnic groups)

	Low PCEs (0–4) Prevalence	High PCEs (5+) Prevalence	High vs Low PCEs RR	Ethnic differences RR
White	7.9%	4.9%	0.62***	Ref
Mixed	8.6%	4.8%	0.56	0.90
Asian	5.6%	4.4%	0.79	1.27
Black	5.4%	3.3%	0.62	0.99

Note: the Other ethnicity group had very small numbers (N=76), so to enable analyses to run and converge, this had to be dropped from the analyses. Models adjust for gender, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single and adverse childhood experiences. Ethnic differences were examined in an interaction model. *** $p<0.001$, ** $p<0.01$, * $p<0.05$, + $p<0.10$. Sample size N=14,012 (imputed sample). Asian N=902, Black N=358, Mixed N=454, White N=12,299. Results weighted for survey design.

Additional analyses

Robustness checks

Additional analyses were carried out, which are reported in the Appendix. These examine the association between PCEs and youth violence outcomes with additional control variables included as a robustness check. This was done to address the concern that the PCEs that a child experiences in childhood could be influenced by the child's own behaviour. Therefore, child conduct problems reported by parents at age three were added as a potential covariate. Also included in these models are neighbourhood violent crime and general neighbourhood deprivation, which factor out any confounding effect of the neighbourhood in the association between PCEs and youth violence. Results are in Table A3.1.1 (see Appendix). For all three youth violence outcomes, we see that despite these additional controls, PCEs still have a strong and significant association, with only a minor change in the risk ratios compared to the results reported above.

Results using non-imputed data

Analyses were carried out using the smaller non-imputed data sample in order to compare results with those from the main results using the fully imputed sample. These are shown in Table A3.1.2. Results are largely similar to the main results, showing that a higher number of PCEs is associated with a lower risk of youth violence when compared with a low number of PCEs. However, there are some differences, as the non-imputed results follow a less linear pattern, with the lowest risk ratios not being for the highest level of PCEs. On the other hand, the imputed results showed a much clearer linear pattern, with the risk of youth violence decreasing incrementally for each higher level of PCEs and with the lowest risk being for those with the highest level of PCEs. We also see that the available observations or sample sizes are lower (assault perpetration N=6,901, weapon involvement N=4,865 and gang involvement N=4,930). This reduces the statistical power of these analyses, as reflected in many non-significant p-values.

Summary of results for RQ2a: which single and cumulative positive childhood experiences are associated with youth violence, and what are the magnitudes of the associations?

Overall, the examinations found that a high number of PCEs during childhood was associated with a substantial and significant reduction in the risk of youth violence later in adolescence. This reduction was higher for the most serious types of youth violence, such as weapon involvement and gang involvement, and it was lower for assault perpetration.

The examinations of gender differences showed that PCEs were associated with a higher reduction in assault perpetration in females than in males. The same pattern was seen for weapon and gang involvement, but these differences were not statistically significant. In terms of ethnic differences, PCEs were associated with a higher reduction in assault perpetration in those of Black ethnic background compared to White youths, but for weapon and gang involvement, no statistically significant differences were observed.

Results for RQ2b: which specific combinations of positive childhood experiences are most strongly associated with youth violence?

The following will present an examination of which specific combinations of PCEs are most strongly associated with youth violence. The approach taken here was to reduce the PCE measure to only four items, drawing on different combinations of the seven items in the main measure used in our previous analyses. All possible combinations of four PCEs (35 in total) are then examined in relation to youth violence, controlling for the same set of confounders as in our main analyses. For easier comparison across the many combinations of PCEs, a single risk ratio estimate is presented, which focuses on the comparison between those with three or more PCEs vs those with no PCEs.

Positive childhood experience combinations and assault perpetration

Figure 3.2.10 shows the results for all possible combinations of PCEs and their associations with assault perpetration. Risk ratio estimates are ordered from lowest (associated with the highest reduction in assault perpetration) to highest (associated with the lowest reduction) and are represented by the blue line. In grey are the confidence intervals. We see a very slight overlap between the confidence intervals between the lowest risk ratio (RR=0.63, 95% CI:0.57-0.69) and the highest (RR=0.77, 95% CI:0.69.-0.86), indicating that the differences between these measures in terms of their associations with assault perpetration are borderline statistically significant.

Table A3.2.1 (see Appendix) shows the 10 PCE combinations associated with the highest reduction in assault perpetration and the 10 combinations associated with the lowest reduction. The combination of PCEs with the highest reduction is low-risk peers, school connectedness, teacher–child relationship and positive peer experiences. The PCE combination associated with the lowest reduction in assault perpetration is activities and hobbies, safe neighbourhood, feeling safe in the playground and positive peer experiences. Table 3.2.13 shows that those single PCEs associated with the highest reduction in assault perpetration (lowest risk ratios) tend to also feature most frequently among the 10 PCE combinations associated with the highest reduction.

Figure 3.2.10: Associations between different combinations of positive childhood experiences (PCEs) and assault perpetration
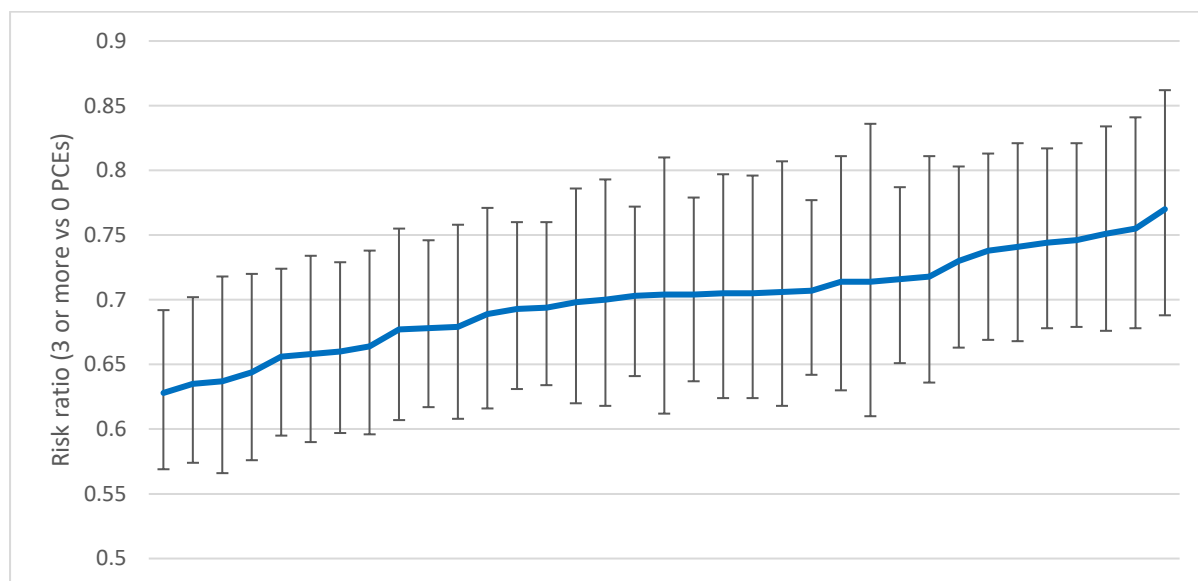
Notes: each combination of four PCEs is examined in its own model. Adjusted for sex at birth, ethnicity, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single and adverse childhood experiences.
Sample size N=14,088 (imputed sample). Results weighted for survey design.

Table 3.2.13: Single positive childhood experiences (PCEs), their association with assault perpetration and their frequency in cumulative PCE measures, with the lowest and highest risk ratio (RR) association with assault perpetration

Single PCE domain	Association with assault perpetration (RR)	Number of times in PCEs with the 10 lowest RR associations with assault perpetration	Number of times in PCEs with the 10 highest RR associations with assault perpetration
Good school connectedness	0.79***	8	4
Low-risk peers	0.80***	9	1
Positive peer experiences	0.82***	7	6
Positive teacher–child relationship	0.87***	7	7
Feeling safe in the playground	0.91***	3	8
Safe neighbourhood	0.93**	2	6
Activities and hobbies	0.95+	2	8

Notes: adjusted for sex at birth, ethnicity, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single and adverse childhood experiences. Sample size N=14,088 (imputed sample). Results weighted for survey design.
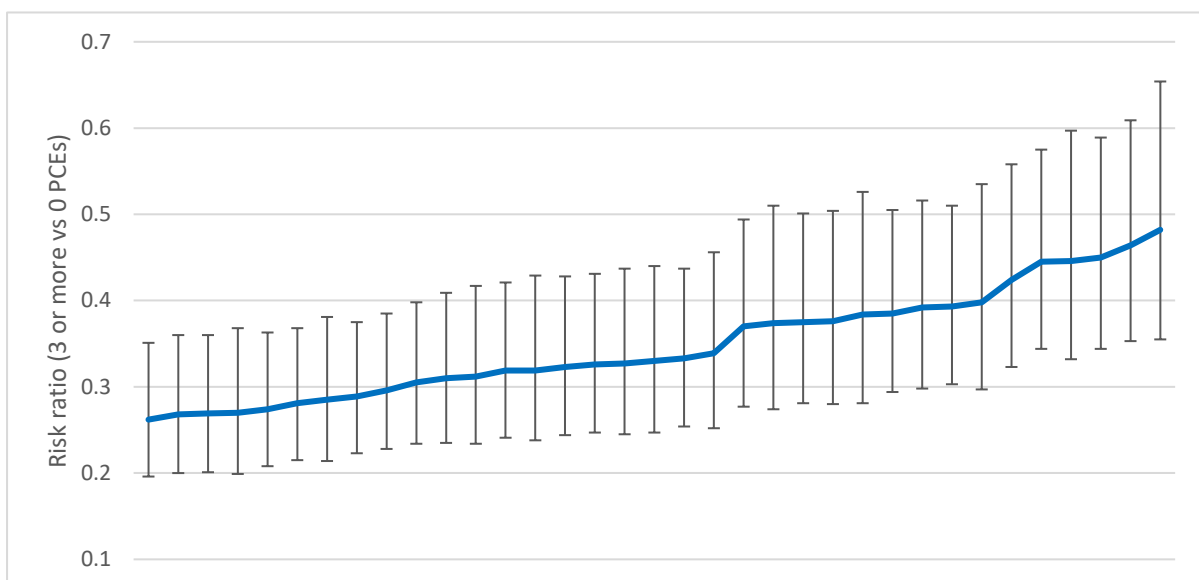
Positive childhood experience combinations and weapon involvement

Figure 3.2.11 presents the results for all possible combinations of PCEs and their associations with weapon involvement. Risk ratios are ordered from lowest (associated with the highest reduction in weapon involvement) to highest (associated with the lowest reduction) and are represented by the blue line. In grey are confidence intervals. Confidence intervals between the lowest risk ratio (RR=0.26, 95% CI:0.20-0.35) and the highest risk ratio (RR=0.48, 95%

CI:0.36.-0.65) are not overlapping, indicating that there are statistically significant differences between these PCE combinations in their association with weapon involvement.

Table A3.2.2 (see Appendix) show the 10 PCE combinations associated with the highest reduction in weapon involvement and the 10 combinations associated with the lowest reduction. The combination of PCEs with the highest reduction is low-risk peers, school connectedness, teacher–child relationship and positive peer experiences. The PCE combination associated with the lowest reduction is activities and hobbies, safe neighbourhood, feeling safe in the playground and positive peer experiences. Table 3.2.14 shows that single PCE items that were associated with the highest reduction in weapon involvement (lowest risk ratios) tend to also feature most frequently among the PCE combinations that were associated with the highest reduction.

Figure 3.2.11: Associations between different combinations of positive childhood experiences (PCEs) and weapon involvement

Notes: each combination of four PCEs is examined in its own model. Adjust for sex at birth, ethnicity, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single and adverse childhood experiences.
Sample size N=14,088 (imputed sample). Results weighted for survey design.

Table 3.2.14: Single positive childhood experiences (PCEs), their association with weapon involvement and their frequency in cumulative PCE measures with the lowest and highest risk ratio (RR) association with weapon involvement

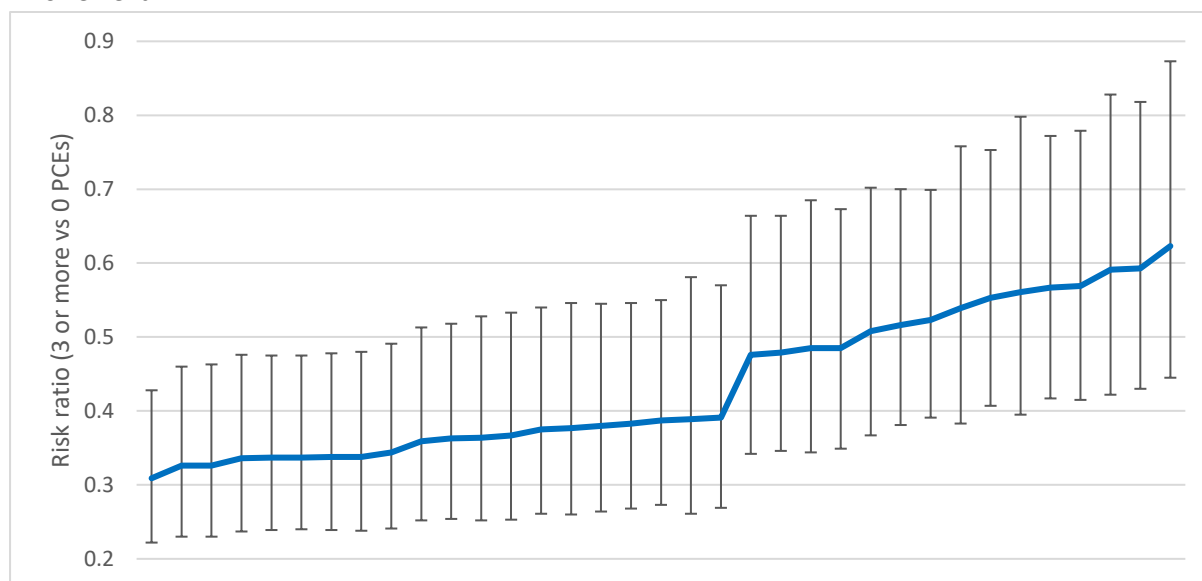| Single PCE domain	Association with weapon involvement (RR)	Number of times in PCEs with the 10 lowest RR associations with weapon involvement	Number of times in PCEs with the 10 highest RR associations with weapon involvement
Low-risk peers	0.50***	10	0
Good school connectedness	0.57***	7	5
Positive teacher–child relationship	0.57***	7	5
Positive peer experiences	0.65***	7	7
Feeling safe in the playground	0.78**	3	7
Safe neighbourhood	0.82*	3	8
Activities and hobbies	0.84*	3	8

Notes: adjusted for sex at birth, ethnicity, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single and adverse childhood experiences. Sample size N=14,088 (imputed sample). Results weighted for survey design.

Positive childhood experience combinations and gang involvement

Figure 3.2.12 shows the results for all possible combinations of PCEs and their associations with gang involvement. Estimates are ordered from the lowest risk ratio (associated with the highest reduction in gang involvement) to the highest (associated with the lowest reduction) and are represented by the blue line. In grey are the confidence intervals. There is no overlap between the confidence intervals between the lowest risk ratio (RR=0.31, 95% CI:0.22-0.43) and the highest (RR=0.62, 95% CI:0.45.-0.87), indicating that the difference between these measures in terms of their association with gang involvement is statistically significant.

Table A3.2.3 (see Appendix) lists the 10 PCE combinations that are associated with the highest reduction in gang involvement and the 10 combinations associated with the lowest reduction, where the single PCEs making up the measures have been included. The combination of PCEs associated with the highest reduction in gang involvement is low-risk peers, school connectedness, teacher–child relationship and positive peer experiences. The PCE combination associated with the lowest reduction is activities and hobbies, safe neighbourhood, feeling safe in the playground and positive peer experiences. Table 3.2.15 shows that those single PCEs that were associated with the largest reduction in gang involvement (lowest risk ratios) also tended to feature most frequently among the 10 PCE combinations associated with the highest reduction.

Figure 3.2.12: Associations between different combinations of positive childhood experiences (PCEs) and gang involvement

Notes: each combination of four PCEs is examined in its own model. Adjust for sex at birth, ethnicity, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single and adverse childhood experiences.
Sample size N=14,088 (imputed sample). Results weighted for survey design.

Table 3.2.15: Single positive childhood experiences (PCEs), their association with gang involvement and their frequency in cumulative PCE measures with the lowest and highest risk ratio (RR) association with gang involvement

Single PCE domain	Association with gang involvement (RR)	Number of times in PCEs with the 10 lowest RR associations with gang involvement	Number of times in PCEs with the 10 highest RR associations with gang involvement
Low-risk peers	0.50***	10	0
Good school connectedness	0.65***	7	6
Positive teacher–child relationship	0.68***	7	4
Positive peer experiences	0.69**	7	7
Feeling safe in the playground	0.81*	3	7
Activities and hobbies	0.91	3	8
Safe neighbourhood	0.91	3	8

Notes: adjusted for sex at birth, ethnicity, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single and adverse childhood experiences.

Summary of results for RQ2b: which specific combinations of positive childhood experiences are most strongly associated with youth violence?

Results of examinations showed that the combination of PCEs that was associated with the highest reduction in youth violence outcomes was low-risk peers, school connectedness, teacher–child relationship and positive peer experiences. These were also the individual PCE items that were associated with the highest reduction in assault perpetration, weapon involvement and gang involvement.

Interactions between adverse and positive childhood experiences in relation to youth violence

Results for RQ3: do positive childhood experiences attenuate the association between adverse childhood experiences and youth violence?

The following section will present examinations of whether PCEs attenuate the positive association between ACEs and youth violence. Both a broader measure and a more detailed measure of the combinations of the levels of ACEs and PCEs were examined.

For the broader measure, binary variables were used to distinguish between a high and low number of ACEs and PCEs. Low ACEs included those exposed to zero to two ACEs risks during childhood, while high ACEs included those exposed to three or more ACEs. Similarly, low PCEs were those with zero to four PCEs, and high PCEs were five or above. This resulted in a four-category ACE and PCE measure (1. high ACEs-high PCEs, 2. high ACEs-low PCEs, 3. low ACEs-high PCEs and 4. low ACEs-low PCEs). This reduction in the number of combinations of ACE and PCE categories provides more statistical power to detect significant associations, and it indicates a broader pattern that having a higher-than-average number of PCEs moderates the association between having a higher-than-average number of ACEs and youth violence.

For the more detailed combined measure, a PCE measure with five levels (capped at six and over) and an ACE measure with six levels (capped at five and over) were used, resulting in a total of 30 combinations of ACE and PCE categories. Although the number of categories reduces statistical power, it enables a more nuanced examination of the potentially protective effect of PCEs for those with a very high number of ACEs.

Assault perpetration: association with adverse childhood experiences by number of positive childhood experiences

Figures 3.3.1 and Table 3.3.1 show the results of examinations of the association between ACEs and assault perpetration by the number of PCEs using the measure with reduced categories. We see that having a high number of PCEs attenuates the detrimental association between ACEs and assault perpetration. Specifically, those with a high number of ACEs and a low number of PCEs have a prevalence of assault perpetration of 49.5%, compared to those with a high number of ACEs and a high number of PCEs (38.4%). This is a reduction in risk of 22% (RR=0.78, p<0.001).

The same pattern is seen in Figure 3.3.2 and Table 3.3.2, which report the results of examining the extended categories of ACEs and PCEs. From the bottom panel in the figure, we see that the protective association of a very high number of PCEs is especially large for those with a very high number of ACEs. Those with five or more ACEs and zero to two PCEs had a prevalence of assault perpetration of 60.3%, compared to 36.5% for those with five or more

ACEs and six to seven PCEs, which is a 40% reduction in the risk of assault perpetration (RR=0.60, p<0.05).

Figure 3.3.1: Prevalence of assault perpetration by adverse childhood experiences (ACEs) and positive childhood experiences (PCEs) (reduced categories)
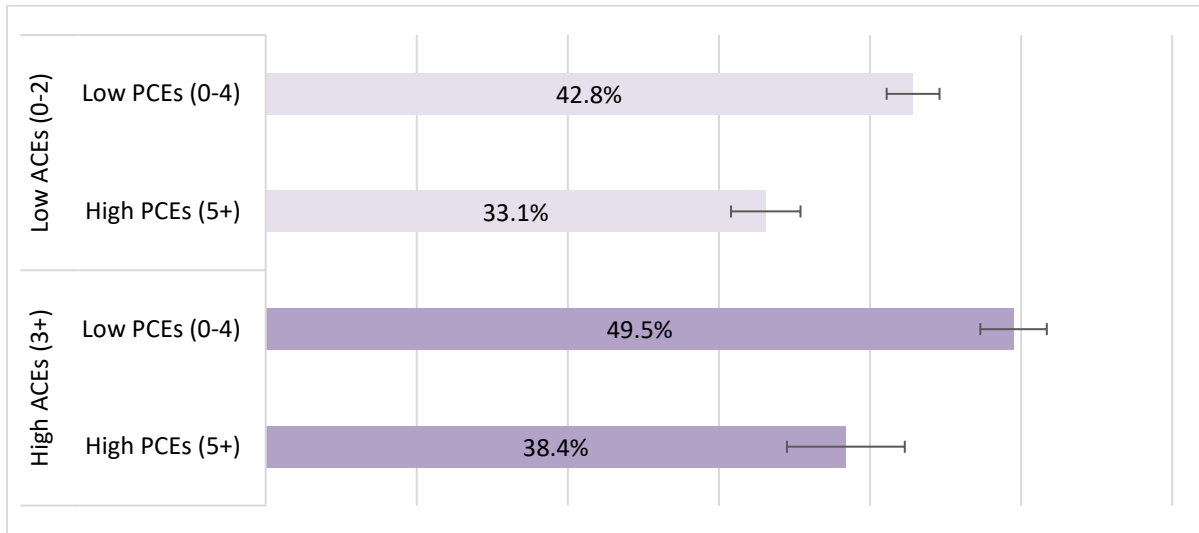
Notes: adjusted for sex at birth, ethnicity, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single. Capped lines indicate 95% confidence intervals. Sample size N=14,088 (imputed sample). Results weighted for survey design.
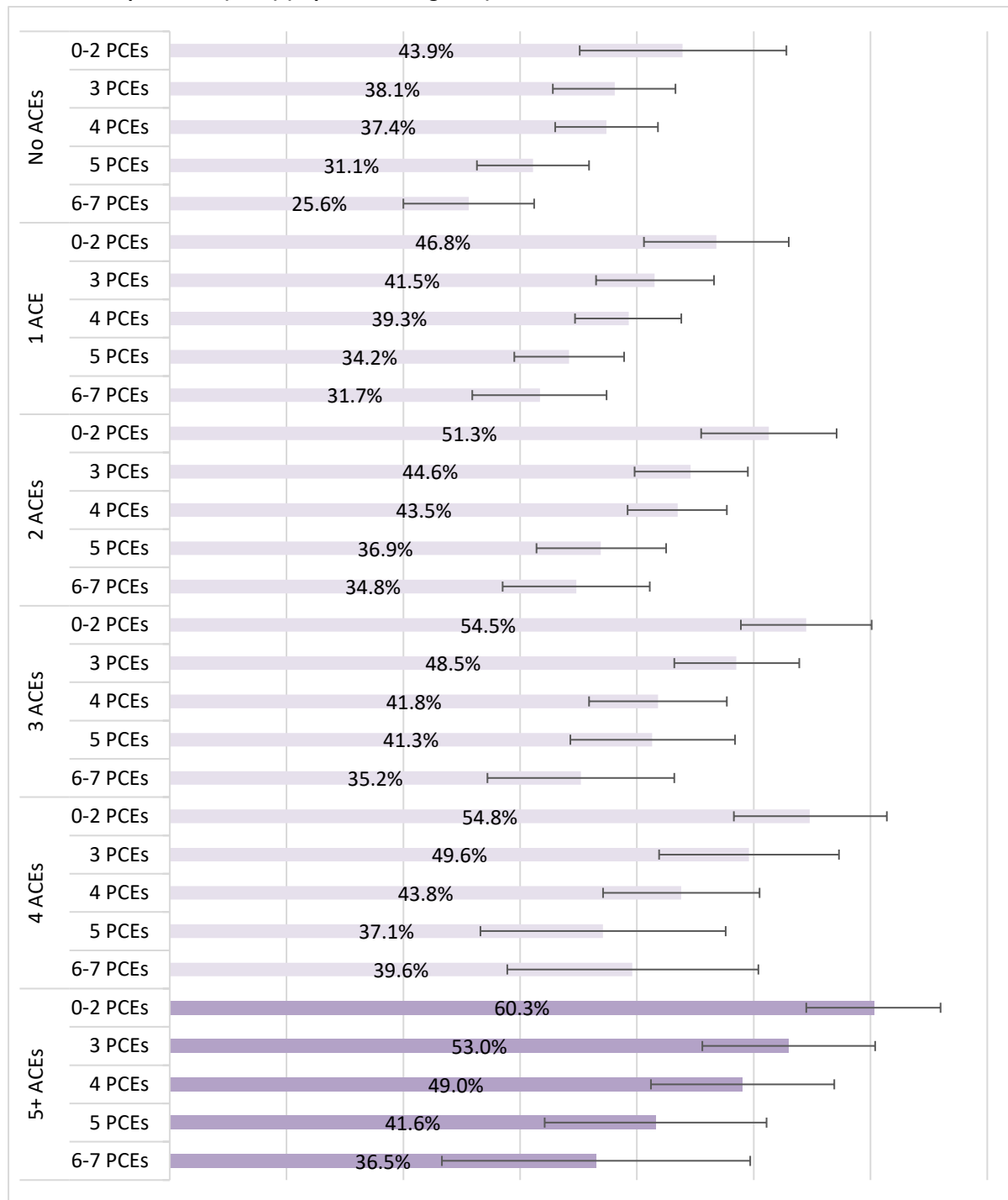
Table 3.3.1: Risk ratio (RR) differences in assault perpetration between high and low positive childhood experiences by level of adverse childhood experiences

		Prevalence	RR
Low ACEs (0–2)	**Low PCEs (0–4)**	42.8%	0.86***
	High PCEs (5+)	33.1%	0.67***
High ACEs (3+)	**Low PCEs (0–4)**	49.5%	Ref
	High PCEs (5+)	38.4%	0.78***

*Notes: a*djusted for ethnicity, maternal age at birth, income, education, occupational status and the number of sweeps the parent was single.

*** p<0.001, ** p<0.01, * p<0.05, + p<0.10**.** Sample size N=14,088 (imputed sample). Results weighted for survey design.

Figure 3.3.2: Prevalence of assault perpetration by adverse childhood experiences (ACEs) and positive childhood experiences (PCEs) (expanded categories)

No ACEs
- 0-2 PCEs: 43.9%
- 3 PCEs: 38.1%
- 4 PCEs: 37.4%
- 5 PCEs: 31.1%
- 6-7 PCEs: 25.6%

1 ACE
- 0-2 PCEs: 46.8%
- 3 PCEs: 41.5%
- 4 PCEs: 39.3%
- 5 PCEs: 34.2%
- 6-7 PCEs: 31.7%

2 ACEs
- 0-2 PCEs: 51.3%
- 3 PCEs: 44.6%
- 4 PCEs: 43.5%
- 5 PCEs: 36.9%
- 6-7 PCEs: 34.8%

3 ACEs
- 0-2 PCEs: 54.5%
- 3 PCEs: 48.5%
- 4 PCEs: 41.8%
- 5 PCEs: 41.3%
- 6-7 PCEs: 35.2%

4 ACEs
- 0-2 PCEs: 54.8%
- 3 PCEs: 49.6%
- 4 PCEs: 43.8%
- 5 PCEs: 37.1%
- 6-7 PCEs: 39.6%

5+ ACEs
- 0-2 PCEs: 60.3%
- 3 PCEs: 53.0%
- 4 PCEs: 49.0%
- 5 PCEs: 41.6%
- 6-7 PCEs: 36.5%

Notes: adjusted for sex at birth, ethnicity, maternal age at birth, income, education, occupational status, and the number of sweeps the parent was single. Capped lines indicate 95% confidence intervals.
Sample size N=14,088 (imputed sample). Results weighted for survey design.

Table 3.3.2: Risk ratio (RR) differences in assault perpetration between levels of positive childhood experiences (PCEs) by levels of adverse childhood experiences (ACEs)

ACEs	PCEs	Prevalence	RR
No ACEs	0–2 PCEs	43.9%	0.74**
	3 PCEs	38.1%	0.64***
	4 PCEs	37.4%	0.63***
	5 PCEs	31.1%	0.52***
	6–7 PCEs	25.6%	0.42***
1 ACE	0–2 PCEs	46.8%	0.79**
	3 PCEs	41.5%	0.70***
	4 PCEs	39.3%	0.66***
	5 PCEs	34.2%	0.57***
	6–7 PCEs	31.7%	0.53***
2 ACEs	0–2 PCEs	51.3%	0.86*
	3 PCEs	44.6%	0.75***
	4 PCEs	43.5%	0.73***
	5 PCEs	36.9%	0.62***
	6–7 PCEs	34.8%	0.58***
3 ACEs	0–2 PCEs	54.5%	0.90
	3 PCEs	48.5%	0.81**
	4 PCEs	41.8%	0.70***
	5 PCEs	41.3%	0.69***
	6–7 PCEs	35.2%	0.58***
4 ACEs	0–2 PCEs	54.8%	0.91
	3 PCEs	49.6%	0.83*
	4 PCEs	43.8%	0.74***
	5 PCEs	37.1%	0.62**
	6–7 PCEs	39.6%	0.66**
5+ ACEs	0–2 PCEs	60.3%	Ref
	3 PCEs	53.0%	0.89
	4 PCEs	49.0%	0.82*
	5 PCEs	41.6%	0.70**
	6–7 PCEs	36.5%	0.60*

*Notes: a*djusted for ethnicity, maternal age at birth, income, education, occupational status and the number of sweeps the parent was single.
*** p<0.001, ** p<0.01, * p<0.05, + p<0.10.
Sample size N=14,088 (imputed sample). Results weighted for survey design.

Examination by gender

Results by gender are shown in Figure 3.3.3 and Table 3.3.3. Among those with a high number of ACEs, we see that having a high number of PCEs compared to a low number of PCEs reduces the risk of assault perpetration by 20% (RR=0.80) for males, and for females, the reduction is

slightly larger at 28% (RR=0.72). However, statistically, this gender difference is not significant.

Figure 3.3.3: Prevalence of assault perpetration by high and low positive childhood experiences (PCEs) by level of adverse childhood experiences (ACEs) (males vs females)
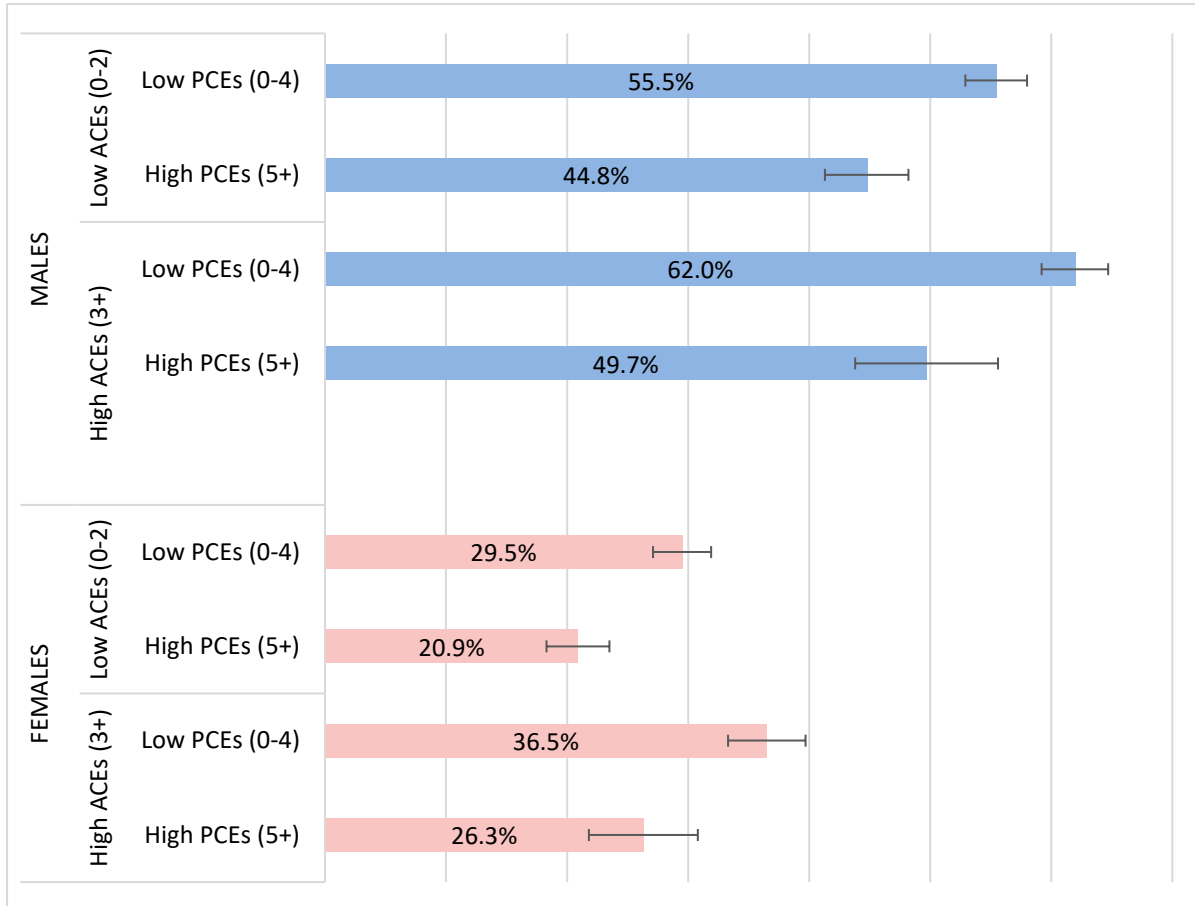
*Notes: a*djusted for ethnicity, maternal age at birth, income, education, occupational status and the number of sweeps the parent was single.

Capped lines indicate 95% confidence intervals.

Sample size N=14,088 (imputed sample). Males N=7,241, females N=6,847. Results weighted for survey design.

Table 3.3.3: Risk ratio (RR) differences in assault perpetration between high and low positive childhood experiences (PCEs) by the level of adverse childhood experiences (ACEs) (males vs females)

|		Males		Females		Gender difference (males)
		Prevalence	RR	Prevalence	RR	RR
Low ACEs (0–2)	**Low PCEs (0–4)**	55.5%	0.90***	29.5%	0.81**	1.11+
	High PCEs (5+)	44.8%	0.72***	20.9%	0.57***	1.26**
High ACEs (3+)	**Low PCEs (0–4)**	62.0%	Ref	36.5%	Ref	Ref
	High PCEs (5+)	49.7%	0.80***	26.3%	0.72**	1.12

*Notes: a*djusted for ethnicity, maternal age at birth, income, education, occupational status and the number of sweeps the parent was single. Gender differences were examined in an interaction model. *** p<0.001, ** p<0.01, * p<0.05, + p<0.10.

Sample size N=14,088 (imputed sample). Males N=7,241, females N=6,847. Results weighted for survey design.

Examination by ethnicity

In terms of ethnic differences, these results are reported in Figure 3.3.4 and Table 3.3.4. The protective association of a high level of PCEs for those with a high level of ACEs is similar for those of White ethnicity and those of ethnic minority backgrounds, with a reduction in the risk of assault perpetration of 22% (RR=0.78) and 24% (RR=0.76), respectively, which is not a significant difference, as reflected in the coefficient, which is close to 1 (0.99).

Figure 3.3.4: Prevalence of assault perpetration by high and low positive childhood experiences (PCEs) by the level of adverse childhood experiences (ACEs) (ethnic minority group vs White group)
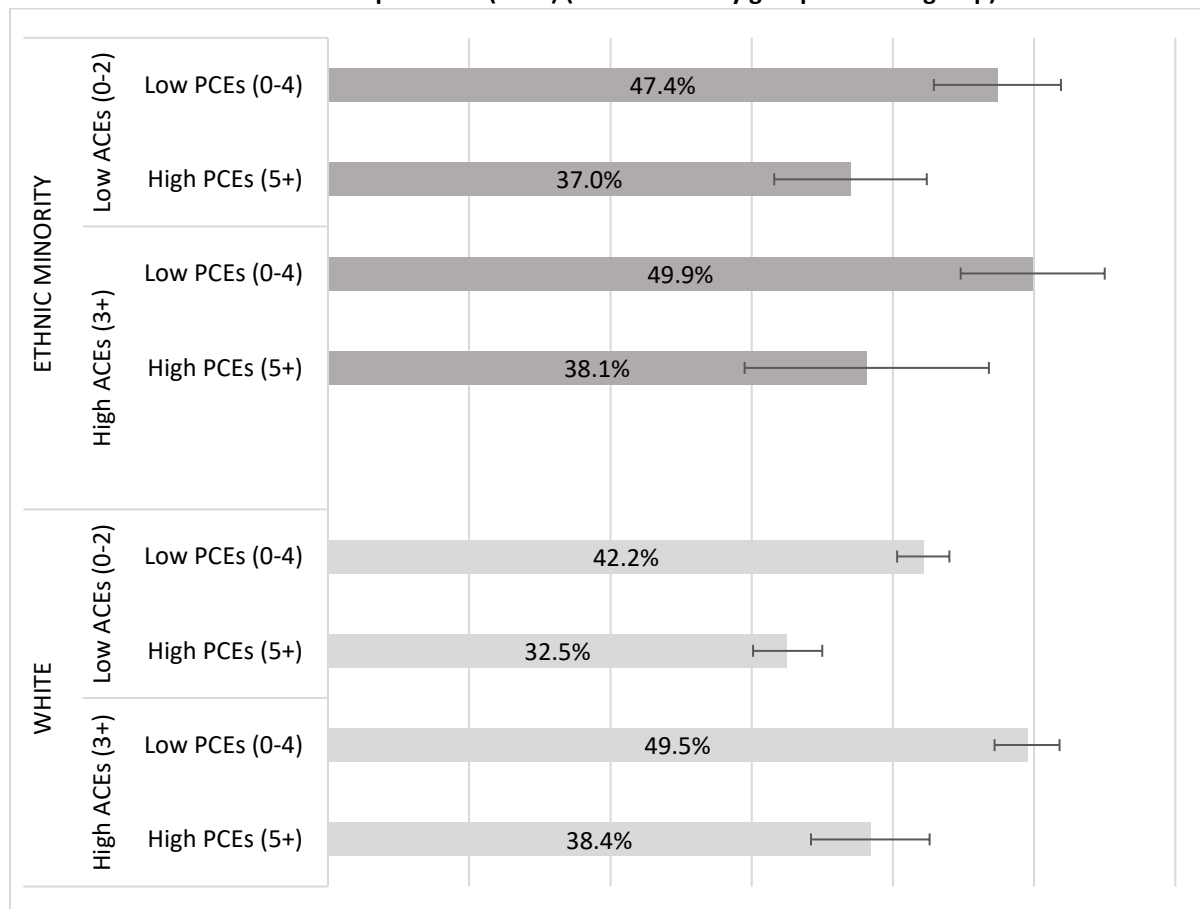
*Notes: a*djusted for sex at birth, maternal age at birth, income, education, occupational status and the number of sweeps the parent was single. Capped lines indicate 95% confidence intervals.
Sample size N=14,088 (imputed sample). Ethnic minority group N=1,789 and White group N=12,299. Results weighted for survey design.

Table 3.3.4: Risk ratio (RR) differences in assault perpetration between high and low positive childhood experiences (PCEs) by the level of adverse childhood experiences (ACEs) (ethnic minority group vs White group)

|		Ethnic minority group		White group		Ethnic difference (minority)
		Prevalence	RR	Prevalence	RR	RR
Low ACEs (0–2)	Low PCEs (0–4)	47.4%	0.95	42.2%	0.85***	1.11
	High PCEs (5+)	37.0%	0.74**	32.5%	0.66***	1.13
High ACEs (3+)	Low PCEs (0–4)	49.9%	Ref	49.5%	Ref	Ref
	High PCEs (5+)	38.1%	0.76*	38.4%	0.78***	0.99

*Notes: a*djusted for sex at birth, maternal age at birth, income, education, occupational status and the number of sweeps the parent was single. Ethnic differences were examined in an interaction model. *** $p<0.001$, ** $p<0.01$, * $p<0.05$, + $p<0.10$**.**

Sample size N=14,088 (imputed sample). Ethnic minority group N=1,789, White group N=12,299. Results weighted for survey design.

Weapon involvement: association with adverse childhood experiences by number of positive childhood experiences

Results of examinations of the association between ACEs and weapon involvement by the number of PCEs using the measure with reduced categories are shown in Figure 3.3.5 and Table 3.3.5. These results show that having a high number of PCEs reduces the association between ACEs and weapon involvement. As shown in the bottom panel of the figure, the prevalence of weapon involvement is 14.0% for those with a high number of ACEs and a low number of PCEs, compared to 7.2% for those with high ACEs and high PCEs. This is a reduction in risk of 49% (RR=0.51, $p<0.001$).

In Figure 3.3.6 and Table 3.3.6, results are shown for the analyses of the variables with extended ACE and PCE categories. We see in the bottom panel that those with five or more ACEs and only zero to two PCEs had a very high rate of weapon involvement (23.7%) compared to those with the same number of ACEs but with six to seven PCEs (7.5%). This is a reduction in risk of 68% (RR=0.32, $p<0.05$).

Figure 3.3.5: Prevalence of weapon involvement by adverse childhood experiences (ACEs) and positive childhood experiences (PCEs) (reduced categories)
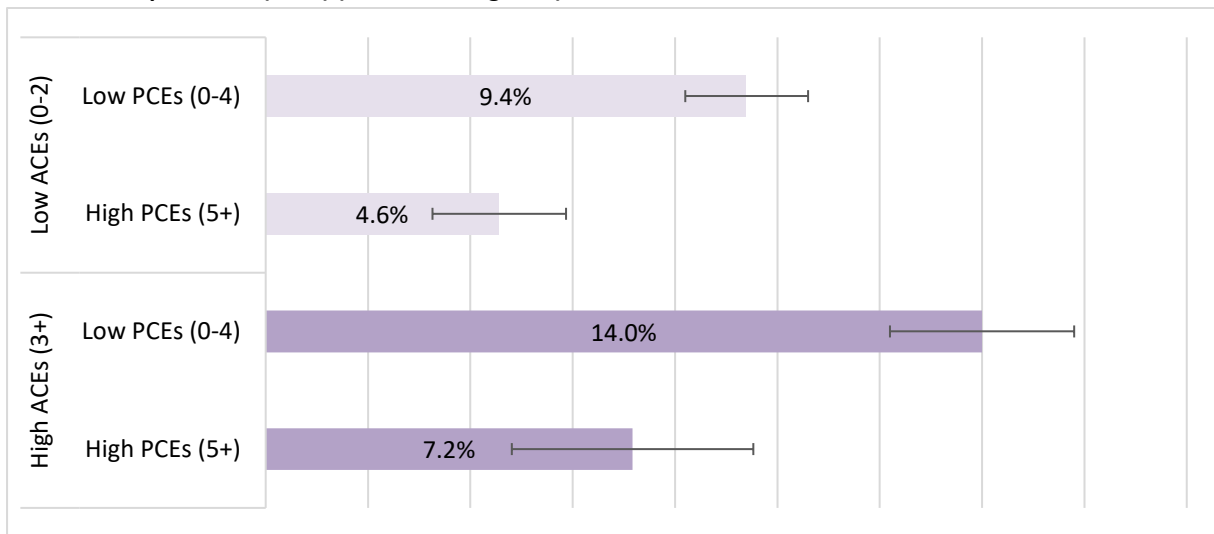
Notes: adjusted for sex at birth, ethnicity, maternal age at birth, income, education, occupational status and the number of sweeps the parent was single. Capped lines indicate 95% confidence intervals.
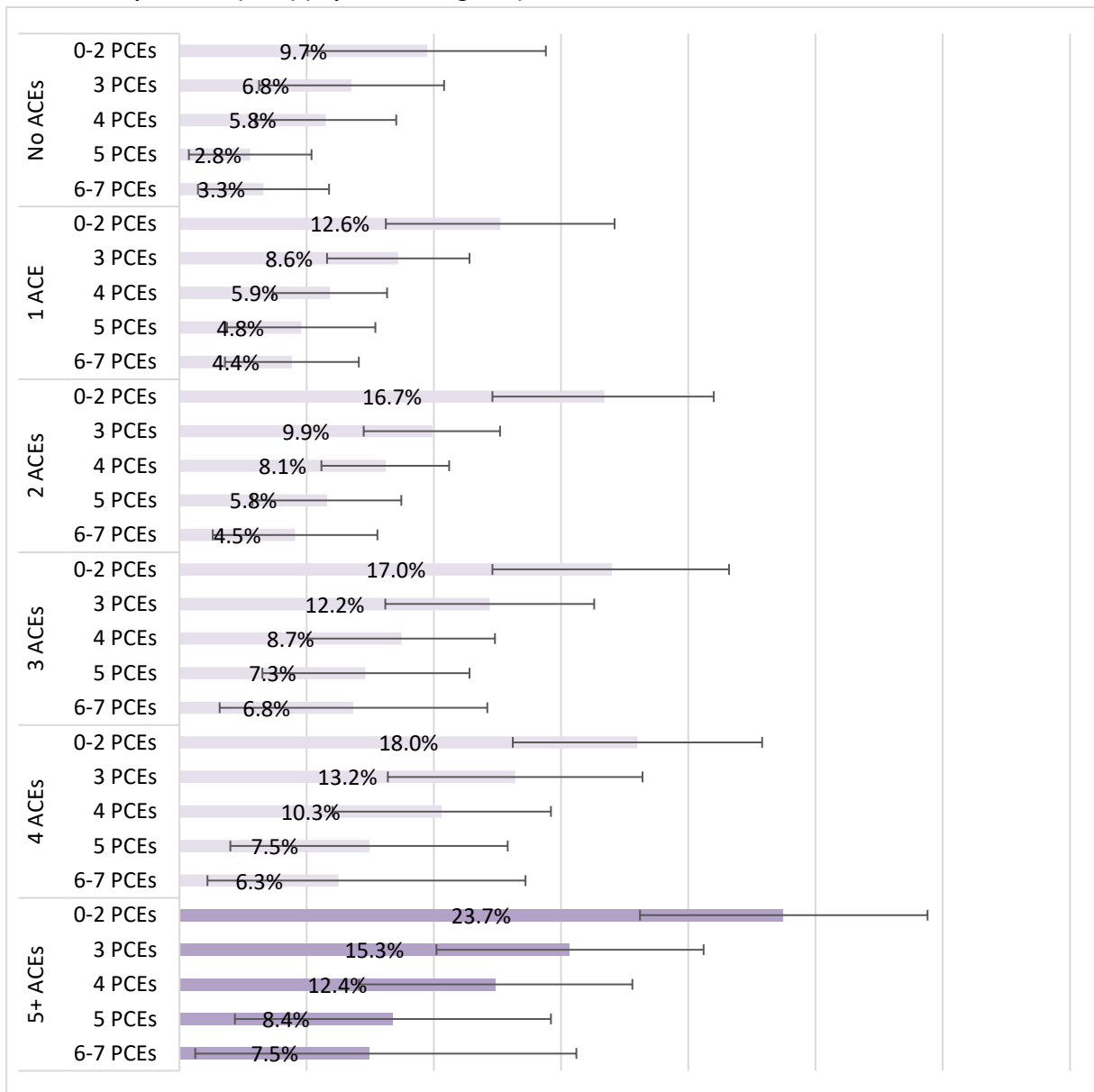Sample size N=14,088 (imputed sample). Results weighted for survey design.

Table 3.3.5: Risk ratio (RR) differences in weapon involvement between high and low positive childhood experiences (PCEs) by level of adverse childhood experiences (ACEs)

		Prevalence	RR
Low ACEs (0–2)	**Low PCEs (0–4)**	9.4%	0.67***
	High PCEs (5+)	4.6%	0.33***
High ACEs (3+)	**Low PCEs (0–4)**	14.0%	Ref
	High PCEs (5+)	7.2%	0.51***

*Notes: a*djusted for sex at birth, ethnicity, maternal age at birth, income, education, occupational status and the number of sweeps the parent was single. *** p<0.001, ** p<0.01, * p<0.05, + p<0.10.

Sample size N=14,088 (imputed sample). Results weighted for survey design.

Figure 3.3.6: Prevalence of weapon involvement by adverse childhood experiences (ACEs) and positive childhood experiences (PCEs) (expanded categories)

Notes: adjusted for sex at birth, ethnicity, maternal age at birth, income, education, occupational status and the number of sweeps the parent was single. Capped lines indicate 95% confidence intervals.

Sample size N=14,088 (imputed sample). Results weighted for survey design.

Table 3.3.6: Risk ratio (RR) differences in weapon involvement between levels of positive childhood experiences (PCEs) by levels of adverse childhood experiences (ACEs)

ACEs	PCEs	Prevalence	RR
No ACEs	0–2 PCEs	9.7%	0.41**
	3 PCEs	6.8%	0.29***
	4 PCEs	5.8%	0.24***
	5 PCEs	2.8%	0.12***
	6–7 PCEs	3.3%	0.14***
1 ACE	0–2 PCEs	12.6%	0.53**
	3 PCEs	8.6%	0.36***
	4 PCEs	5.9%	0.25***
	5 PCEs	4.8%	0.20***
	6–7 PCEs	4.4%	0.19***
2 ACEs	0–2 PCEs	16.7%	0.70+
	3 PCEs	9.9%	0.42***
	4 PCEs	8.1%	0.34***
	5 PCEs	5.8%	0.24***
	6–7 PCEs	4.5%	0.19***
3 ACEs	0–2 PCEs	17.0%	0.72+
	3 PCEs	12.2%	0.51**
	4 PCEs	8.7%	0.37***
	5 PCEs	7.3%	0.31***
	6–7 PCEs	6.8%	0.29**
4 ACEs	0–2 PCEs	18.0%	0.76
	3 PCEs	13.2%	0.56**
	4 PCEs	10.3%	0.43***
	5 PCEs	7.5%	0.32**
	6–7 PCEs	6.3%	0.26*
5+ ACEs	0–2 PCEs	23.7%	1.00
	3 PCEs	15.3%	0.66*
	4 PCEs	12.4%	0.52**
	5 PCEs	8.4%	0.35**
	6–7 PCEs	7.5%	0.32*

*Notes: a*djusted for sex at birth, ethnicity, maternal age at birth, income, education, occupational status and the number of sweeps the parent was single. *** $p<0.001$, ** $p<0.01$, * $p<0.05$, + $p<0.10$
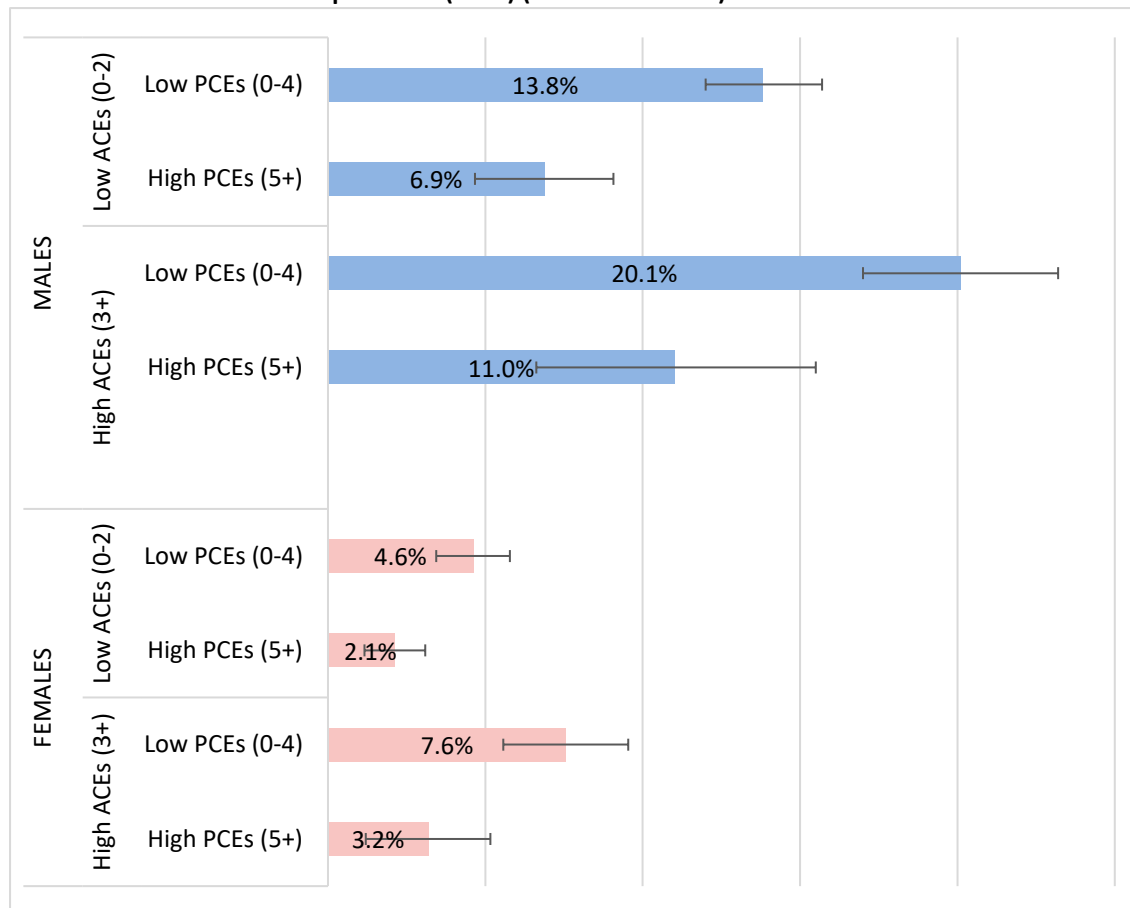Sample size N=14,088 (imputed sample). Results weighted for survey design.

Examination by gender

Figure 3.3.7 and Table 3.3.7 report results by gender on the extent to which PCEs attenuate the association between ACEs and weapon involvement. For those with a high level of ACEs, having a high number of PCEs compared to low PCEs is associated with a reduction in risk of weapon involvement for males by 45% (RR=0.55, p<.01), and for females, the reduction is larger at 58% (RR=0.42, p<.05). However, statistically, this gender difference is not significant.

Because of the low prevalence of weapon involvement, the statistical power for these subgroup analyses is likely compromised.

Figure 3.3.7: Prevalence of weapon involvement by high and low positive childhood experiences (PCEs) by level of adverse childhood experiences (ACEs) (males vs females)

*Notes: a*djusted for ethnicity, maternal age at birth, income, education, occupational status and the number of sweeps the parent was single.
Capped lines indicate 95% confidence intervals.
Sample size N=14,088 (imputed sample). Males N=7,241, females N=6,847. Results weighted for survey design.

Table 3.3.7: Risk ratio (RR) differences in weapon involvement between high and low positive childhood experiences (PCEs) by level of adverse childhood experiences (ACEs) (males vs females)

|		Males		Females		Gender difference (males)
		Prevalence	RR	Prevalence	RR	RR
Low ACEs (0–2)	**Low PCEs (0–4)**	13.8%	0.69***	4.6%	0.61**	1.13
	High PCEs (5+)	6.9%	0.34***	2.1%	0.28***	1.22
High ACEs (3+)	**Low PCEs (0–4)**	20.1%	Ref	7.6%	Ref	Ref
	High PCEs (5+)	11.0%	0.55**	3.2%	0.42*	1.30

*Notes: a*djusted for ethnicity, maternal age at birth, income, education, occupational status and the number of sweeps the parent was single. Gender differences were examined in an interaction model. *** p<0.001, ** p<0.01, * p<0.05, + p<0.10.
Sample size N=14,088 (imputed sample). Males N=7,241, females N=6,847. Results weighted for survey design.

Examination by ethnicity

Results by ethnicity are shown in Figure 3.3.8 and Table 3.3.8. These show that the protective association of a high level of PCEs for those with a high level of ACEs is 50% (RR=0.50) for those of White ethnicity and 43% (RR=0.57) for those of ethnic minority backgrounds, but this difference is not statistically significant. A lack of statistical power could be a factor in the absence of a real difference being observed.

Figure 3.3.8: Prevalence of weapon involvement by high and low positive childhood experiences (PCEs) by the level of adverse childhood experiences (ACEs) (ethnic minority group vs White group)
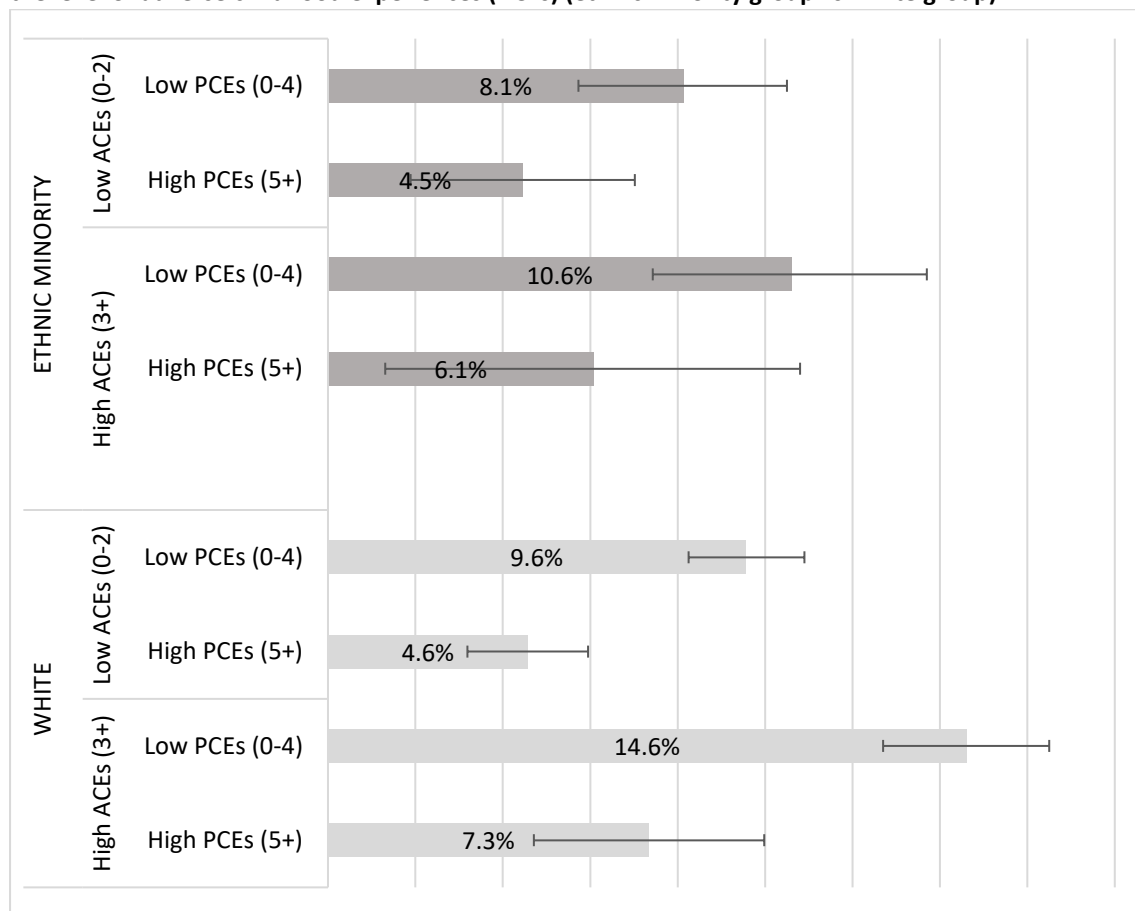
*Notes: a*djusted for sex at birth, maternal age at birth, income, education, occupational status and the number of sweeps the parent was single. Capped lines indicate 95% confidence intervals.
Sample size N=14,088 (imputed sample). Ethnic minority group N=1,789, White group N=12,299. Results weighted for survey design.

Table 3.3.8: Risk ratio (RR) differences in weapon involvement between high and low positive childhood experiences (PCEs) by the level of adverse childhood experiences (ACEs) (ethnic minority group vs White group)

		Ethnic minority group		White group		Ethnic difference (minority)
		Prevalence	RR	Prevalence	RR	
Low ACEs (0–2)	Low PCEs (0–4)	8.1%	0.77	9.6%	0.65***	1.17
	High PCEs (5+)	4.5%	0.42**	4.6%	0.31***	1.34
High ACEs (3+)	Low PCEs (0–4)	10.6%	Ref	14.6%	Ref	Ref
	High PCEs (5+)	6.1%	0.57	7.3%	0.50***	1.11

*Notes: a*djusted for sex at birth, maternal age at birth, income, education, occupational status and the number of sweeps the parent was single. Ethnic differences were examined in an interaction model. *** p<0.001, ** p<0.01, * p<0.05, + p<0.10.
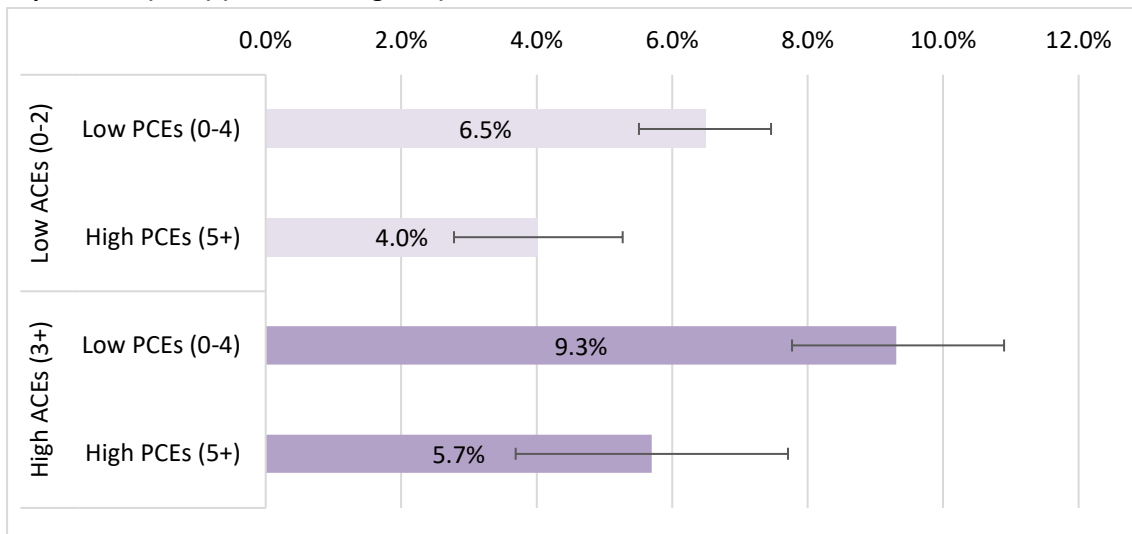Sample size N=14,088 (imputed sample). Ethnic minority group N=1,789, White group N=12,299. Results weighted for survey design.

Gang involvement: association with adverse childhood experiences by the number of positive childhood experiences

Figure 3.3.9 and Table 3.3.9 show the results of examinations of the associations between ACEs and gang involvement by the number of PCEs using reduced categories measures. Results show that PCEs attenuate the associations between ACEs and gang involvement. We see that those with a high number of ACEs and a low number of PCEs had a prevalence of 9.3%, compared to 5.7% for those with high ACEs and high PCEs, which is a reduction in risk of 39% (RR=0.61, p<0.01).

Figure 3.3.10 and Table 3.3.10 show the results of the extended ACE and PCE categories. The prevalence of gang involvement was 15.1% for those with five or more ACEs and zero to two PCEs, compared to 6.6% for those with five or more ACEs and six to seven PCEs, which is a reduction in risk of 56%, although this was not statistically significant. However, for five or more ACEs and five PCEs, we see a statistically significant reduction of 50% (RR=0.50, p<.05) in gang involvement compared to having zero to two PCEs. This strongly indicates that for the analyses of the higher six to seven PCEs group, statistical power is a limiting factor due to gang involvement having the lowest prevalence of all the youth violence outcomes and the large number of combinations of ACE and PCE categories.

Figure 3.3.9: Prevalence of gang involvement by adverse childhood experiences (ACEs) and positive childhood experiences (PCEs) (reduced categories)

Notes: adjusted for sex at birth, ethnicity, maternal age at birth, income, education, occupational status and the number of sweeps the parent was single. Capped lines indicate 95% confidence intervals.
Sample size N=14,088 (imputed sample). Results weighted for survey design.

Table 3.3.9: Risk ratio (RR) differences in gang involvement between high and low positive childhood experiences (PCEs) by the level of adverse childhood experiences (ACEs)

		Prevalence	RR
Low ACEs (0–2)	Low PCEs (0–4)	6.5%	0.70***
	High PCEs (5+)	4.0%	0.43***
High ACEs (3+)	Low PCEs (0–4)	9.3%	Ref
	High PCEs (5+)	5.7%	0.61***

Notes: adjusted for sex at birth, ethnicity, maternal age at birth, income, education, occupational status and the number of sweeps the parent was single. *** p<0.001, ** p<0.01, * p<0.05, + p<0.10.
Sample size N=14,088 (imputed sample). Results weighted for survey design.

Figure 3.3.10: Prevalence of gang involvement by adverse childhood experiences (ACEs) and positive childhood experiences (PCEs) (expanded categories)

Notes: adjusted for sex at birth, ethnicity, maternal age at birth, income, education, occupational status and the number of sweeps the parent was single. Capped lines indicate 95% confidence intervals.
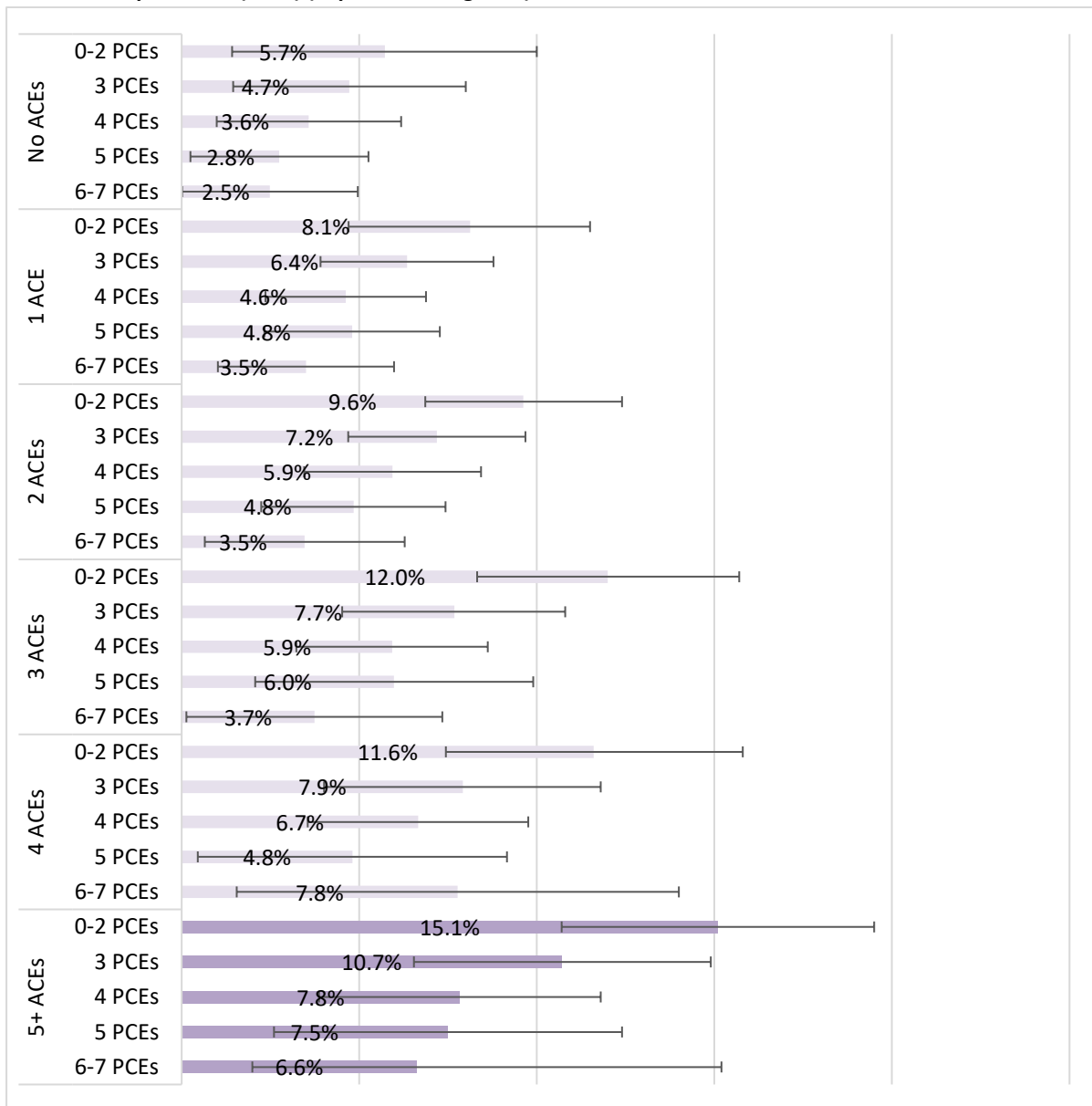Sample size N=14,088 (imputed sample). Results weighted for survey design.

Table 3.3.10: Risk ratio (RR) differences in gang involvement between levels of positive childhood experiences (PCEs) by the levels of adverse childhood experiences (ACEs)

ACEs	PCEs	Prevalence	RR
No ACEs	0–2 PCEs	5.7%	0.38*
	3 PCEs	4.7%	0.31**
	4 PCEs	3.6%	0.24***
	5 PCEs	2.8%	0.17***
	6–7 PCEs	2.5%	0.16***
1 ACE	0–2 PCEs	8.1%	0.54*
	3 PCEs	6.4%	0.42***
	4 PCEs	4.6%	0.31***
	5 PCEs	4.8%	0.32***
	6–7 PCEs	3.5%	0.23***
2 ACEs	0–2 PCEs	9.6%	0.64*
	3 PCEs	7.2%	0.48**
	4 PCEs	5.9%	0.39***
	5 PCEs	4.8%	0.32***
	6–7 PCEs	3.5%	0.23**
3 ACEs	0–2 PCEs	12.0%	0.79
	3 PCEs	7.7%	0.51**
	4 PCEs	5.9%	0.39***
	5 PCEs	6.0%	0.40*
	6–7 PCEs	3.7%	0.25*
4 ACEs	0–2 PCEs	11.6%	0.77
	3 PCEs	7.9%	0.52*
	4 PCEs	6.7%	0.44**
	5 PCEs	4.8%	0.32*
	6–7 PCEs	7.8%	0.51
5+ ACEs	0–2 PCEs	15.1%	1.00
	3 PCEs	10.7%	0.71
	4 PCEs	7.8%	0.52*
	5 PCEs	7.5%	0.50*
	6–7 PCEs	6.6%	0.44

Notes: adjusted for sex at birth, ethnicity, maternal age at birth, income, education, occupational status and the number of sweeps the parent was single. *** $p<0.001$, ** $p<0.01$, * $p<0.05$, + $p<0.10$
Sample size N=14,088 (imputed sample). Results weighted for survey design.

Examination by gender

Figure 3.3.11 and Table 3.3.11 report these examinations by gender. Among those with a high number of ACEs, we observe that having a high number of PCEs, compared to low PCEs, reduces the risk of assault perpetration in males by 41% (RR=0.59), and for females, the reduction is smaller, at 34% (RR=0.66). However, statistically, this gender difference is not

significant. The previously highlighted caveat regarding statistical power in these analyses is referred to.

Figure 3.3.11: Prevalence of gang involvement by high and low positive childhood experiences (PCEs) by the level of adverse childhood experiencs (ACEs) (males vs females)
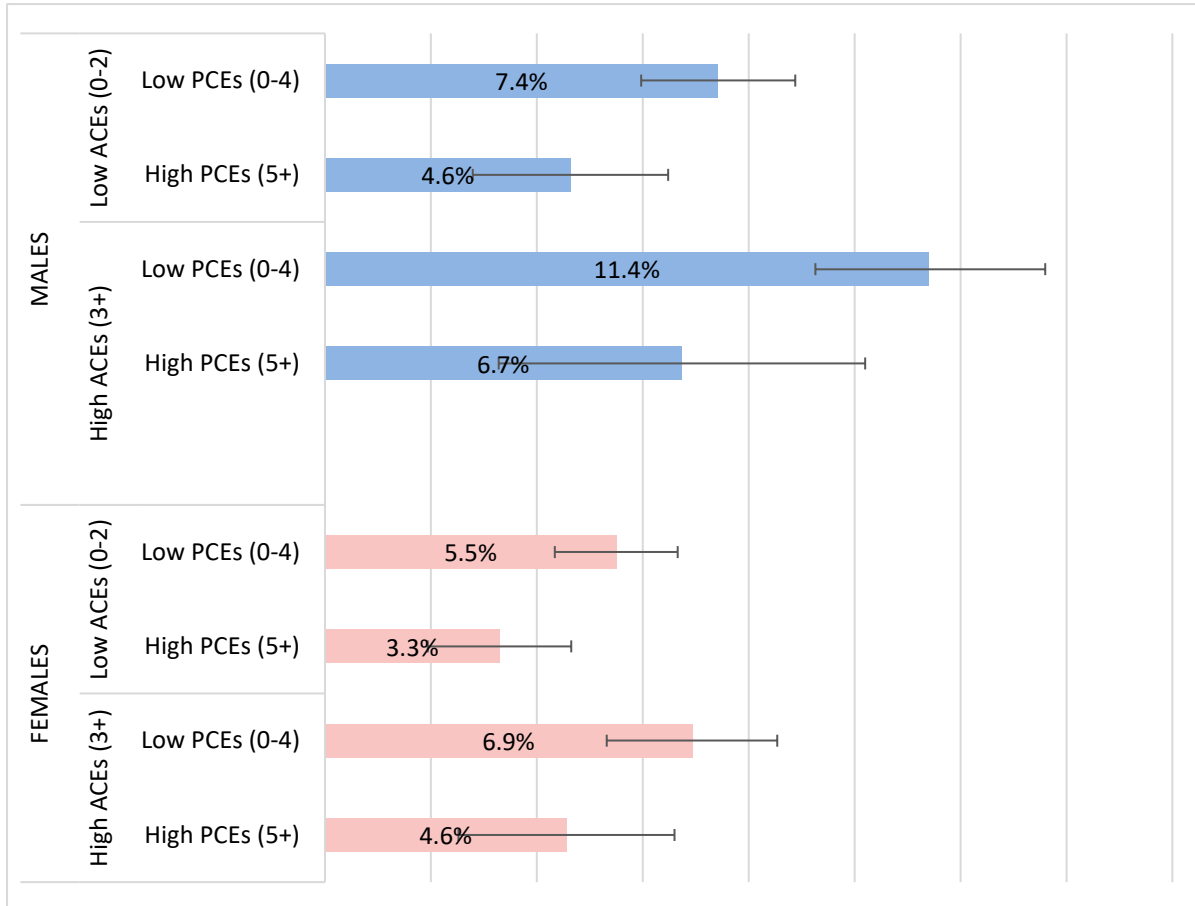
Notes: adjusted for ethnicity, maternal age at birth, income, education, occupational status and the number of sweeps the parent was single.
Capped lines indicate 95% confidence intervals.
Sample size N=14,088 (imputed sample). Males N=7,241, females N=6,847. Results weighted for survey design.

Table 3.3.11: Risk ratio (RR) differences in gang involvement between high and low positive childhood experiences (PCEs) by the level of adverse childhood experiences (ACEs) (males vs females)

|		Males		Females		Gender difference (males)
		Prevalence	RR	Prevalence	RR	RR
Low ACEs (0–2)	**Low PCEs (0–4)**	7.4%	0.65**	5.5%	0.79	0.82
	High PCEs (5+)	4.6%	0.41***	3.3%	0.48**	0.85
High ACEs (3+)	**Low PCEs (0–4)**	11.4%	Ref	6.9%	Ref	Ref
	High PCEs (5+)	6.7%	0.59*	4.6%	0.66	0.90

Notes: adjusted for ethnicity, maternal age at birth, income, education, occupational status and the number of sweeps the parent was single. Gender differences were examined in an interaction model. *** p<0.001, ** p<0.01, * p<0.05, + p<0.10.
Sample size N=14,088 (imputed sample). Males N=7,241, females N=6,847. Results weighted for survey design.

Examination by ethnicity

Figure 3.3.12 and Table 3.3.12 report the results by ethnicity. These show that the associated reduction from having a high level of PCEs for those with a high level of ACEs is largely similar by ethnicity; this was 39% (RR=0.61) for those of White ethnicity and 41% (RR=0.59) for those of ethnic minority backgrounds, and this difference is not statistically significant.

Figure 3.3.12: Prevalence of gang involvement by high and low positive childhood experiences (PCEs) by the level of adverse childhood experiences (ACEs) (ethnic minority group vs White group)
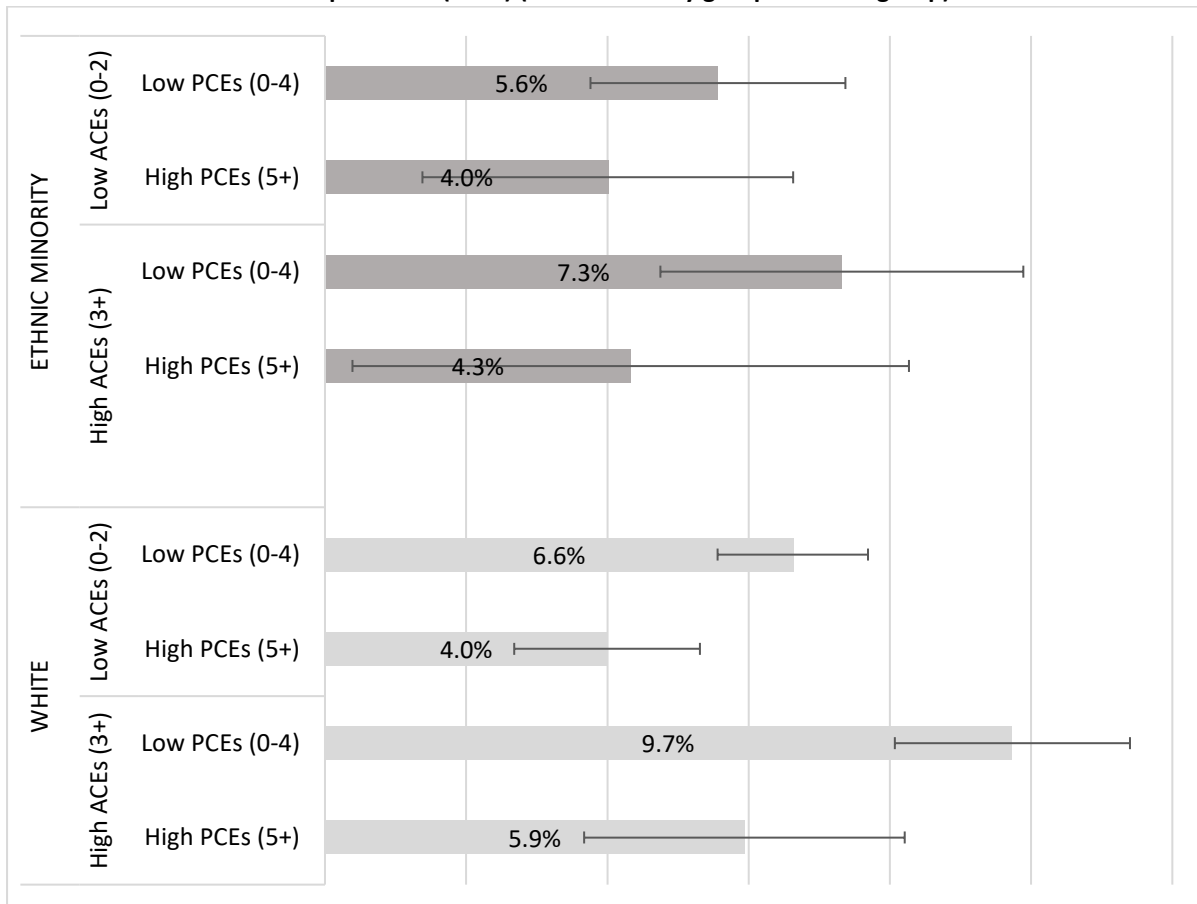
Notes: adjusted for sex at birth, maternal age at birth, income, education, occupational status and the number of sweeps the parent was single. Capped lines indicate 95% confidence intervals.
Sample size N=14,088 (imputed sample). Ethnic minority group N=1,789, White group N=12,299. Results weighted for survey design.

Table 3.3.12: Risk ratio (RR) differences in gang involvement between high and low positive childhood experiences (PCEs) by the level of adverse childhood experiences (ACEs) (ethnic minority group vs White group)

		Ethnic minority group		White group		Ethnic difference (minority)
		Prevalence	RR	Prevalence	RR	RR
Low ACEs (0–2)	Low PCEs (0–4)	5.6%	0.76	6.6%	0.68**	1.12
	High PCEs (5+)	4.0%	0.55	4.0%	0.41***	1.33
High ACEs (3+)	Low PCEs (0–4)	7.3%	Ref	9.7%	Ref	Ref
	High PCEs (5+)	4.3%	0.59	5.9%	0.61*	0.93

Notes: adjusted for sex at birth, maternal age at birth, income, education, occupational status and the number of sweeps the parent was single. Ethnic differences were examined in an interaction model. *** $p<0.001$, ** $p<0.01$, * $p<0.05$, + $p<0.10$.
Sample size N=14,088 (imputed sample). Ethnic minority group N=1,789, White group N=12,299. Results weighted for survey design.

Summary of results for RQ3: do positive childhood experiences attenuate the association between adverse childhood experiences and youth violence?

The overall results show that having a high number of PCEs attenuated the detrimental association between ACEs and youth violence, with a greater reduction in risk for weapon involvement and gang involvement than for assault perpetration. Examinations by gender and ethnicity showed no consistent pattern, with very small and non-significant differences between groups.

# Neighbourhood violent crime in relation to youth violence

Results for RQ4: to what extent is neighbourhood violent crime using police.uk data a valid and reliable measure?

In this section, we present results evaluating the appropriateness of using police.uk data to characterise the level of violent crime at the LSOA level. We first compare rankings of LSOAs in terms of crime based on data from police.uk and the IMD from England and Wales (RQ4a). Then, time series created from police.uk data are compared with Home Office data (RQ4b).

RQ4a: to what extent is the measure of neighbourhood crime using police.uk data consistent with the measure of neighbourhood crime using the IMD?

Figures 3.4.1 and 3.4.2 show the overlap of neighbourhood crime quintiles between police.uk data and IMD data in England and Wales. The denominator is the total number of LSOAs (i.e. neighbourhoods), and percentages indicate the fraction of LSOAs classified in each quintile. For England, the horizontal axis in Figure 3.4.1 indicates quintiles of neighbourhood crime based on ranks from the 2010 IMD Crime Domain. For Wales, the horizontal axis in Figure 3.4.2 shows quintiles based on ranks from the 2011 Community Safety Index. For both figures, the vertical axes are quintiles of crime rates at the LSOA level, created from 2011 police.uk data and mid-2011 LSOA population estimates. The diagonal, from bottom left to top right, shows the percentage of LSOAs with the same quintile classification in both data sets. Adding up these diagonal values for England, we see that, overall, 41.8% of LSOAs are classified the same across data sets. We also see that the agreement in classification is higher for the highest quintile (11.5/20=57.5%) and the lowest quintile (11.2/20=56.0%) than for the middle quintiles. This suggests a higher lever level of agreement between data sets in high- and low-crime neighbourhoods. A similar pattern is seen for Wales, with an overall agreement between data sets for 44.2% of LSOAs, again with higher agreement rates for the neighbourhoods in the highest quintile (12.5/20=62.5%) and the lowest quintile (11.9/20=59.5%). In Figures A3.4.1 and A3.4.2 (see Appendix), we show similar results but using deciles instead of quintiles.

Figure 3.4.1. Classification by quintiles of neighbourhood crime (Lower Super Output Area [LSOA]), England
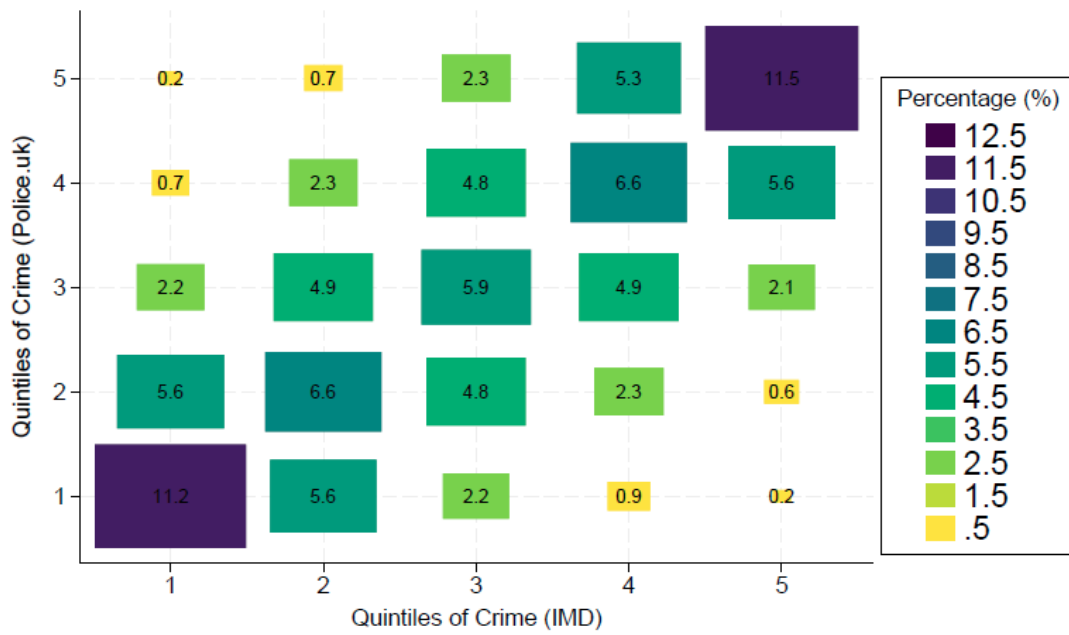
Note: total number of LSOAs in England considered in this figure is 32,670.

Figure 3.4.2. Classification by quintiles of neighbourhood crime (Lower Super Output Area [LSOA]), Wales
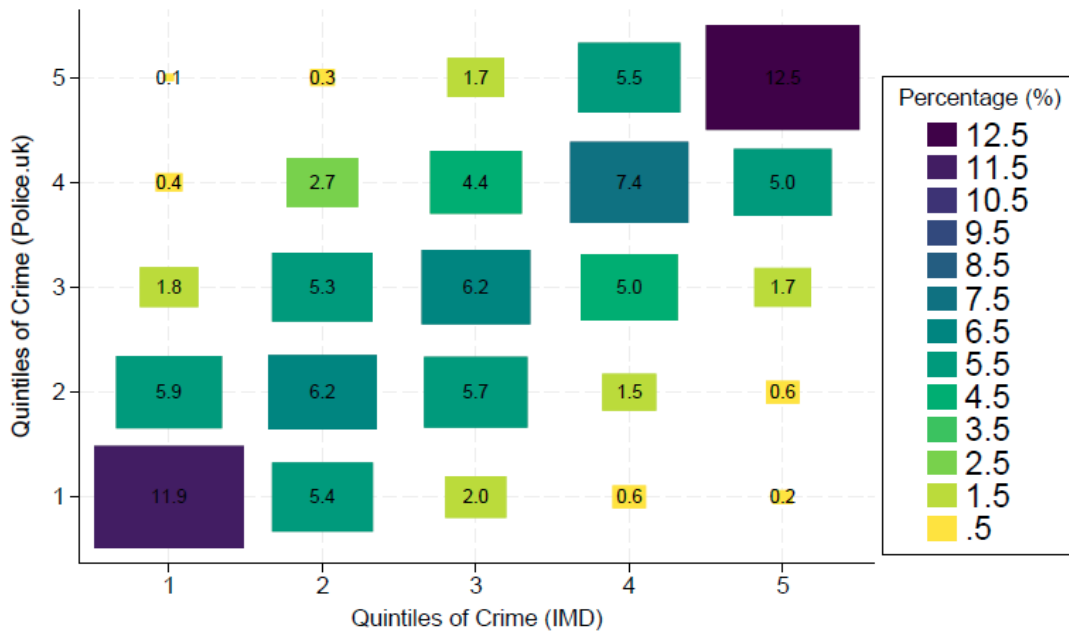
Note: total number of LSOAs in Wales considered in this figure is 1,890.

RQ4b: does the police.uk violent crime measure show the same national trend over time (2011–2018) as the published Home Office statistics on crime in England and Wales?

Figure 3.4.3 shows trends in violence and sexual offences in police.uk and Home Office data between 2011 and 2018, and the quarterly difference in number of incidents between both time series is shown in Figure 3.4.4. Results indicate that there are no major differences in national trends of violence and sexual offences between data sets (see Figure 3.4.3).

Overall, the quarterly number of violence and sexual offences in Home Office data is larger than in police.uk data (see Figure 3.4.4). The exception is the first three quarters of 2011, with around 8,000–14,000 more quarterly offences recorded in police.uk data than in Home Office data. The 2011 figure is observed across most regions in England and Wales, as shown in Figures 3.4.5 and 3.4.6. These regional figures report a ratio defined as offences in police.uk data divided by offences in Home Office data. Ratios above (below) 1 indicate that police.uk data include more (less) offences than Home Office data. Differences by police forces in England are reported in the Appendix in Figures A3.4.3–A3.4.11.

Some differences are observed between quarterly figures between both data sets, particularly for 2011. While this may be a concern when creating quarterly area-level crime measures, this issue may be attenuated in the context of our study since we plan to use longer periods, such as 2011–2013, to characterise the crime level in a small area. Table 3.4.1 shows the number of violence and sexual offences for both data sets and by region, and we summarise these statistics for 2011–2013, showing that the quarterly differences are hugely attenuated when offences are aggregated across several years.

Figure 3.4.3. Trends in violence and sexual offences
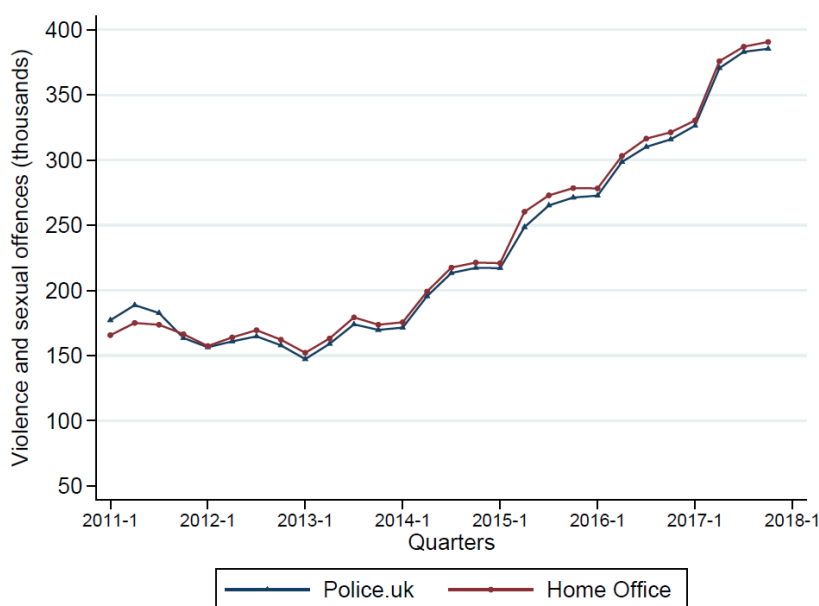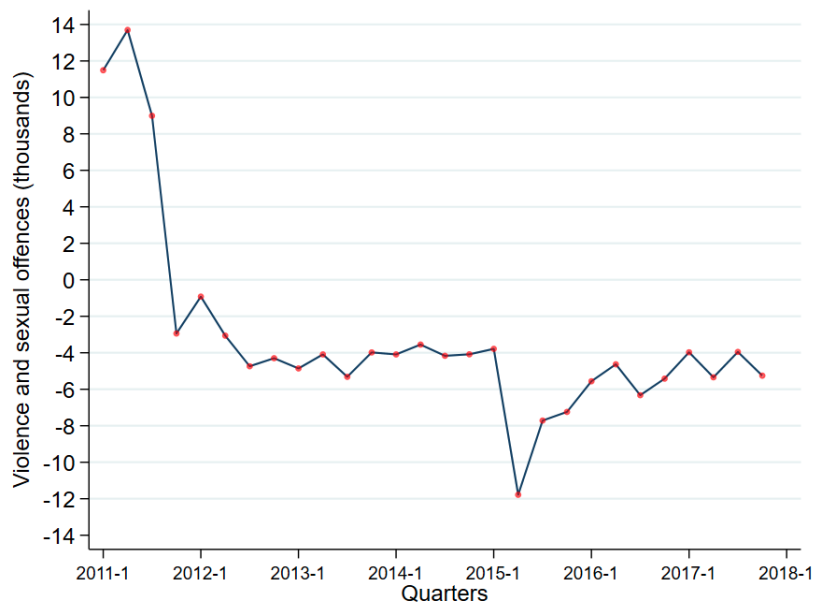
Figure 3.4.4. Differences in trends in violence and sexual offences

Notes: this figure reports a ratio defined as offences in police.uk data divided by offences in Home Office data. Ratios above (below) 1 indicate that police.uk data include more (less) offences than Home Office data.

Figure 3.4.5. Differences in trends in violence and sexual offences by region in England
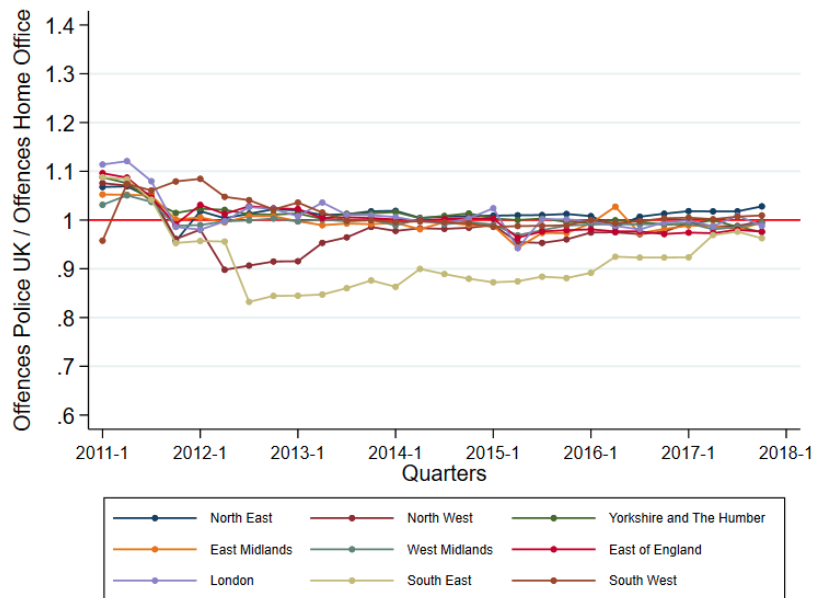
Figure 3.4.6. Differences in trends in violence and sexual offences by region in Wales
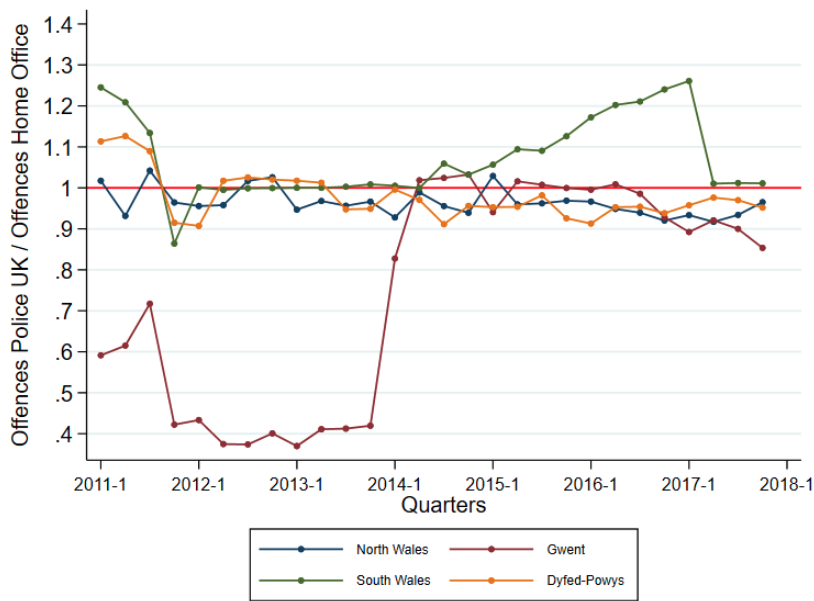
Table 3.4.1: Number of violence and sexual offences (thousands), 2011–2013

	Police.uk (1)	Home Office (2)	Difference in number of offences	Ratio = (1)/(2)
Total	2001.69	2001.72	0.0	1.00
England				
North East	71.3	69.7	1.6	1.02
North West	241.0	247.6	-6.6	0.97
Yorkshire and The Humber	173.1	168.4	4.7	1.03
East Midlands	160.7	158.6	2.1	1.01
West Midlands	200.2	198.6	1.6	1.01
East of England	186.5	181.2	5.3	1.03
London	423.7	410.0	13.7	1.03
South East	267.9	287.0	-19.1	0.93
South West	183.5	177.3	6.2	1.03
Wales				
North Wales	27.1	27.7	-0.6	0.98
Gwent	9.2	19.8	-10.6	0.46
South Wales	45.3	43.8	1.6	1.04
Dyfed-Powys	12.2	12.0	0.1	1.01

Summary of results for RQ4: implications for analyses of neighbourhood crime in relation to youth violence

There are several implications from the results regarding how to use police.uk data to create the variable neighbourhood violent crime, an LSOA-level measure of violent crime in the context of our study.

- Results in RQ4a show that our measure of crime in police.uk data has a reasonable level of agreement with the crime measures in the IMD. The agreement is largest for the

neighbourhoods with the highest and lowest levels of crime. This is encouraging and suggests that further analyses should focus on comparing these two ends of the spectrum, with a third category capturing the middle range of neighbourhood crime.

- The lack of perfect overlap between police.uk and IMD data is likely due to methodological differences, but it also indicates there are other aspects of area deprivation that our measure might not be able to capture. In the final regression analysis, it would, therefore, be beneficial to control for the overall level of deprivation in the LSOA using the overall IMD.

- Besides characterising crime in small areas based only on 'violence and sexual offences', it would be sensible to create an additional measure of neighbourhood crime which additionally considers other categories. A reasonable approach is to include those considered in the Crime Domain of IMD, such as burglary, theft and criminal damage. While including these other categories adds offences that are considered less violent, it could help to mitigate potential biases arising from the small number of violent and sexual offences reported in some LSOAs.

- A good reason for using police.uk crime data in our further study, rather than IMD data, is that IMD crime measures are made up of different components in England and Wales and are, therefore, based on ranks within each of these UK countries. This would mean that analyses would have to be carried out separately for England and Wales and that any differences in results may be due to IMD differences rather than country differences. Statistical power could also be compromised by splitting the analyses by country.

- As suggested by the results in RQ4b that compares police.uk data with Home Office data, measures of neighbourhood crime should be created by counting all incidents of crime in 2012 and 2013 (prior to the measurement of age 14 and 17 youth violence in the MCS) to avoid potential biases due to over- or under-counting offences in the police.uk data. We, therefore, suggest omitting data from 2011, which showed inconsistencies between data sets. A reasonable denominator for the LSOA crime rate is the mid-2012 resident population estimate at the LSOA level.

- We, therefore, propose that the measure of neighbourhood violent crime to be taken forward and examined in relation to youth violence are crimes recorded by the police at the neighbourhood level covering the years 2012 and 2013. This is a continuous measure of the number of violent crimes per thousand residents in mid-2012. The rate is created by counting the number of incidents of crime reported to the police in each neighbourhood (LSOA) of participants in the MCS and dividing it by the mid-2012 resident population estimate in the same LSOA. The category of crimes labelled as 'violence and sexual offences' in the police.uk data is used in this study. Additionally, a second measure of general neighbourhood crime will be considered, including the following categories: violence and sexual offences, burglary, theft, and criminal damage.

- Once these neighbourhood crime measures have been constructed for all LSOAs in England and Wales, we will categorise LSOAs into groups depending on the level of crime

in the area: high or low. These groupings (quintiles, tertiles and binary) will be adapted to the specific analyses being carried out, considering, in particular, issues of statistical power. The derived variables will be linked to MCS data using the LSOA of cohort members' residences, as described in the analysis plan.

Results for RQ5: are rates of violent crime in one's neighbourhood associated with youth violence?

The following will present results of examinations of whether violent crime in the neighbourhood where young people grow up is associated with their involvement in violence.

The main focus is on violent crime, but a secondary measure of general crime in the neighbourhood is also examined in additional analyses. Both are continuous measures of the number of crimes per 1,000 resident population. In the analyses, these are transformed into quintiles: lowest 20%, lowest 20–40%, middle 40–60%, highest 60–80% and highest 80–100%. In the analyses that examine subgroups (gender and ethnicity), the tertile measure of violent neighbourhood crime was used (lowest 0–33%, middle 33–66% and highest 66–100%). The reference category in the analyses is the group with the lowest level of crime, to which all the other groups are compared using risk ratios.

Models are run in two parts: first, neighbourhood crime is entered on its own, and then control variables on child and family characteristics are added (demographic and socioeconomic variables, ACEs and PCEs). The family-level control variables are very important control variables to include as these are the main drivers of selection into neighbourhoods. People come to live in neighbourhoods based on socioeconomic and demographic factors, such as education, occupational status and ethnicity. These factors are also related to youth violence outcomes. As a robustness check, additional analyses are carried out that include neighbourhood deprivation as an additional control variable.

As additional analyses, models are also run with continuous measures (standardized z scores) of neighbourhood crime to check that the grouping into quintiles does not affect results, as statistical power can be reduced when categorising variables.

Assault perpetration

Figure 3.5.1 and Table 3.5.1 show the results of examinations of the association between rates of violent crime in the neighbourhood and the likelihood of young people engaging in assault perpetration. In Model 1, which is the unadjusted association, we see that the prevalence of assault perpetration is greater for those growing up in neighbourhoods with higher levels of violent crime. Specifically, in neighbourhoods with the highest 80–100% violent crime, the prevalence of assault perpetration was 44.5%, compared to 39.3% for those in neighbourhoods with the lowest 20% levels of violent crime. As shown in Table 3.5.1, this is a risk ratio of 1.13 (p<0.01), or an increase in risk of 13%.

In Model 2, where child- and family-level variables are controlled for, the association attenuates and is no longer statistically significant. However, it is still going in the expected direction, with a very slight increase in the prevalence of assault perpetration for those in neighbourhoods with the highest level of violent crime (42.3%) compared to those in neighbourhoods with the lowest (40.8).

Figure 3.5.1: Prevalence of assault perpetration by neighbourhood violent crime
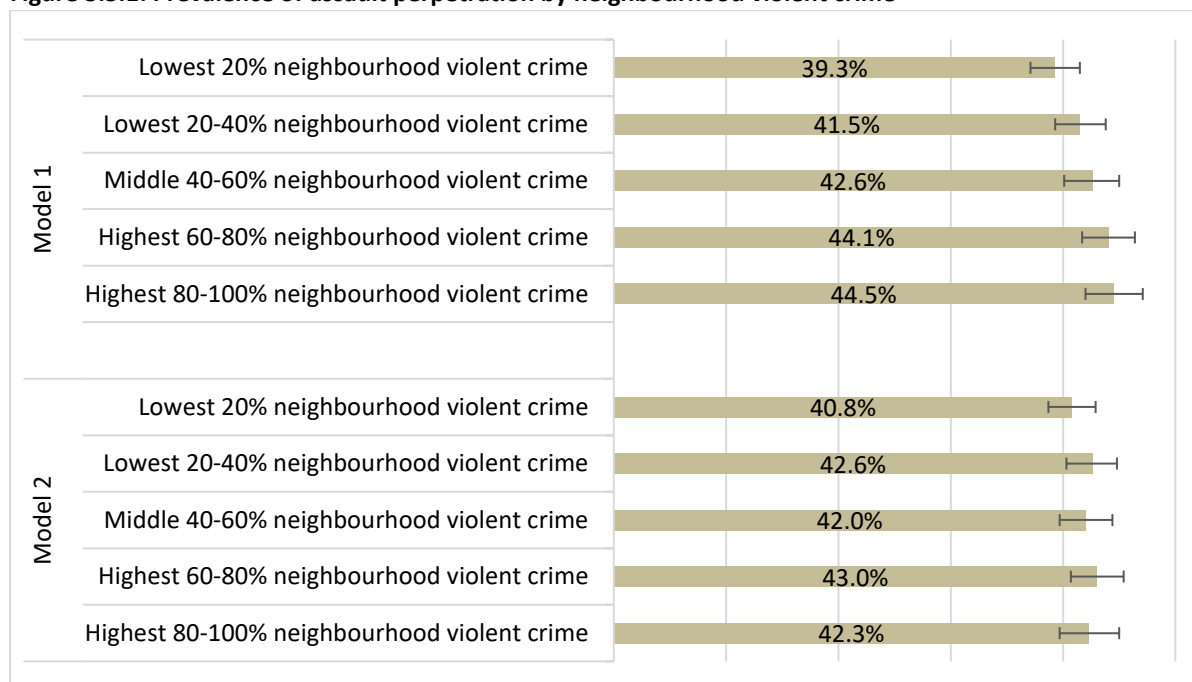
Notes: Model 1: not adjusted for any other variables. Model 2: adjusted for sex at birth, ethnicity, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single, adverse childhood experiences and positive childhood experiences. Capped lines indicate 95% confidence intervals.
Sample size N=14,088 (imputed sample). Results weighted for survey design.

Table 3.5.1: Risk ratio (RR) differences in assault perpetration between neighbourhoods with varying levels of violent crime

	Model 1 (unadjusted)		Model 2 (adjusted)	
	Prevalence	RR	Prevalence	RR
Lowest 20% neighbourhood violent crime	39.3%	Ref	40.8%	Ref
Lowest 20–40% neighbourhood violent crime	41.5%	1.06	42.6%	1.04
Middle 40–60% neighbourhood violent crime	42.6%	1.08*	42.0%	1.03
Highest 60–80% neighbourhood violent crime	44.1%	1.12**	43.0%	1.05
Highest 80–100% neighbourhood violent crime	44.5%	1.13**	42.3%	1.04

Notes: Model 1: not adjusted for any other variables. Model 2: adjusted for sex at birth, ethnicity, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single, adverse childhood experiences and positive childhood experiences. *** $p<0.001$, ** $p<0.01$, * $p<0.05$, + $p<0.10$. Sample size N=14,088 (imputed sample). Results weighted for survey design.

Examination by gender

Results of the fully adjusted Model 2 examined by gender are reported in Figure 3.5.2 and Table 3.5.2. This shows that the lack of association between neighbourhood violent crime is especially applicable to males, but there is a slightly larger but still small and non-significant association for females. This gender difference is, however, statistically significant, suggesting that females are slightly more at risk for assault perpetration if growing up in a neighbourhood with a high level of violent crime.

Figure 3.5.2: Prevalence of assault perpetration by neighbourhood violent crime (males vs females)
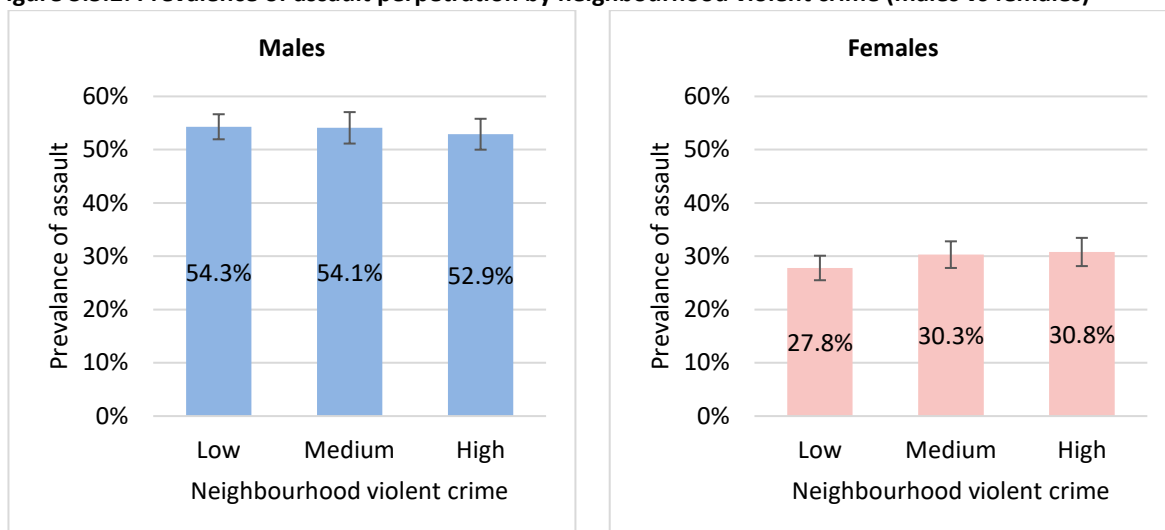
Notes: models adjust for ethnicity, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single, adverse childhood experiences and positive childhood experiences. Capped lines indicate 95% confidence intervals.
Sample size N=14,088 (imputed sample). Males N=7,241, females N=6,847. Results weighted for survey design.

Table 3.5.2: Prevalence of assault perpetration by neighbourhood violent crime (males vs females)

	Males		Females		Gender difference (males)
	Prevalence	RR	Prevalence	RR	RR
Neighbourhood violent crime					
Low 0–33%	54.3%	Ref	27.8%	Ref	Ref
Medium 33–66%	54.1%	1.00	30.3%	1.09	0.89
High 66–100%	52.9%	0.97	30.8%	1.11	0.85*

Notes: models adjust for ethnicity, maternal age at birth, income, education, occupational status, and number of sweeps parent was single, and ACEs and PCEs. Gender difference was examined in an interaction model. *** p<0.001, ** p<0.01, * p<0.05, + p<0.10.
Sample size N=14,088 (imputed sample). Males N=7,241, Females N=6,847. Results weighted for survey design. RR=risk ratio

Examination by ethnicity

Ethnic differences are examined and reported in Figure 3.5.3 and Table 3.5.3. Overall, these show that there are no statistically significant differences when comparing those of White ethnic background to other groups. Nevertheless, it is notable that for all ethnic minority groups, there is a 'reverse' association, as the risk of assault perpetration is highest in low violence neighbourhoods, which is largest for those of Black ethnicity, followed by Asian and then Mixed ethnic backgrounds.

Figure 3.5.3: Prevalence of assault perpetration by neighbourhood violent crime (ethnic groups)
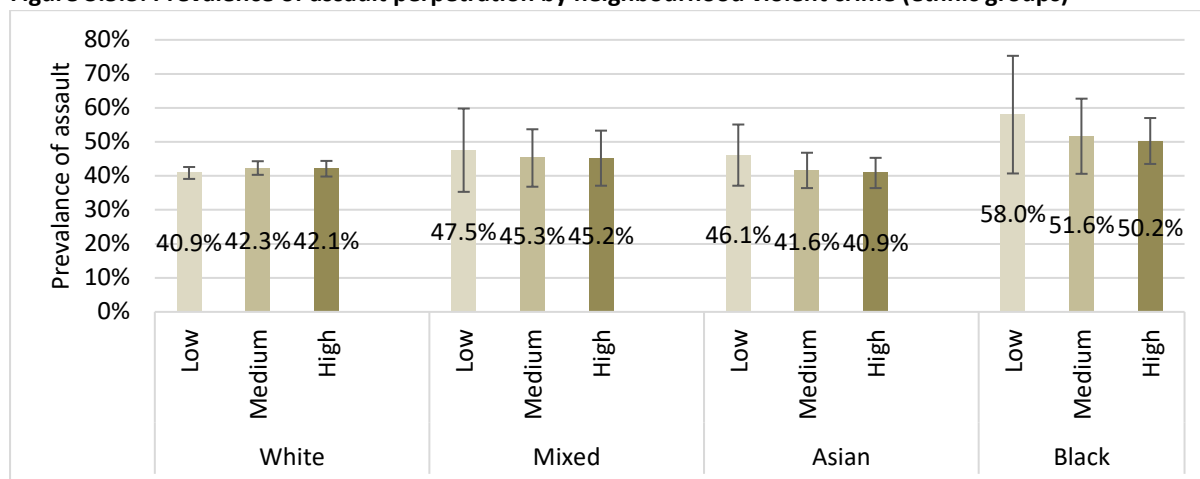
Note: Other ethnicity was a category with very small numbers (N=76), so to enable analyses to run and converge, this had to be dropped from the analyses. Models adjust for sex at birth, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single, adverse childhood experiences and positive childhood experiences. Capped lines indicate 95% confidence intervals. Sample size N=14,012 (imputed sample). Asian N=902, Black N=358, Mixed N=454, White N=12,299. Results weighted for survey design.

Table 3.5.3: Prevalence of assault perpetration by neighbourhood violent crime (ethnic groups)

| | Neighbourhood violent crime | | | | Ethnic differences |
| | **Low** | **Medium** | **High** | **High vs Low** | |
	Prevalence	Prevalence	Prevalence	RR	RR
White	40.9%	42.3%	42.1%	1.03	Ref
Mixed	47.5%	45.3%	45.2%	0.95	0.92
Asian	46.1%	41.6%	40.9%	0.89	0.86
Black	58.0%	51.6%	50.2%	0.87	0.84

Note: the Other ethnicity category had very small numbers (N=76), so to enable analyses to run and converge, this had to be dropped from the analyses. Models adjust for sex at birth, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single, adverse childhood experiences and positive childhood experiences. Ethnic differences were examined in an interaction model. *** p<0.001, ** p<0.01, * p<0.05, + p<0.10.
Sample size N=14,012 (imputed sample). Asian N=902, Black N=358, Mixed N=454, White N=12,299. Results weighted for survey design. RR=risk ratio

Weapon involvement

Figure 3.5.4 and Table 3.5.4 show the results of the examination of the association between neighbourhood violent crime and young people's weapon involvement. In Model 1, which is the unadjusted results, we see that weapon involvement is significantly higher for those from neighbourhoods with the highest level of violent crime. Specifically, the prevalence was 12.2% for those in neighbourhoods with the highest 80–100% levels of violent crime, compared to a prevalence of 7.6% for those in neighbourhoods with the lowest 20% level. This is a 1.62 risk ratio (p<.001), which is an increase in risk of 62%.

By introducing individual and family variables into Model 2, the association attenuates markedly with no statistically significant difference in weapon involvement between those from high vs low violent crime neighbourhoods. With this adjustment, the prevalence of weapon involvement was 10.0% for those from the highest 80–100% violent crime neighbourhoods, compared to 9.3% for those in the lowest 20% violent crime areas.

Figure 3.5.4: Prevalence of weapon involvement by neighbourhood violent crime
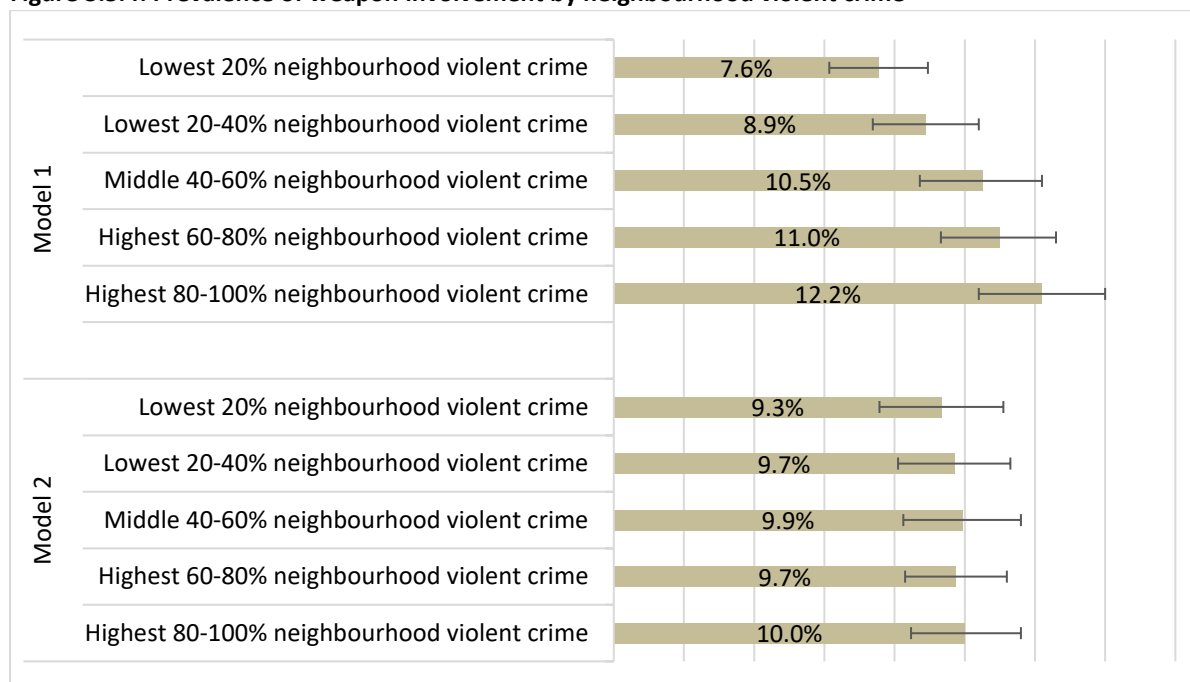
Notes: Model 1: not adjusted for any other variables. Model 2: adjusted for sex at birth, ethnicity, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single, adverse childhood experiences and positive childhood experiences. Capped lines indicate 95% confidence intervals. Sample size N=14,088 (imputed sample). Results weighted for survey design.

Table 3.5.4: Risk ratio (RR) differences in weapon involvement between neighbourhoods with varying levels of violent crime

	Model 1 (unadjusted)		Model 2 (adjusted)	
	Prevalence	RR	Prevalence	RR
Lowest 20% neighbourhood violent crime	7.6%	Ref	9.3%	Ref
Lowest 20–40% neighbourhood violent crime	8.9%	1.18	9.7%	1.04
Middle 40–60% neighbourhood violent crime	10.5%	1.39**	9.9%	1.06
Highest 60–80% neighbourhood violent crime	11.0%	1.46***	9.7%	1.04
Highest 80–100% neighbourhood violent crime	12.2%	1.62***	10.0%	1.07

Notes: Model 1: not adjusted for any other variables. Model 2: adjusted for sex at birth, ethnicity, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single, adverse childhood experiences and positive childhood experiences. *** p<0.001, ** p<0.01, * p<0.05, + p<0.10. Sample size N=14,088 (imputed sample). Results weighted for survey design.

Examination by gender

Figure 3.5.5 and Table 3.5.5 show examinations by gender using the fully adjusted model. The lack of association is especially notable for males, who have largely the same prevalence of weapon involvement across the three levels of neighbourhood crime. For females, the association was slightly stronger, with those in both medium- and high-violence neighbourhoods having a slightly elevated level of weapon involvement, although not statistically significantly higher than those in low-violence neighbourhoods, and neither were these gender differences statistically significant.

Figure 3.5.5: Prevalence of weapon involvement by neighbourhood violent crime (males vs females)
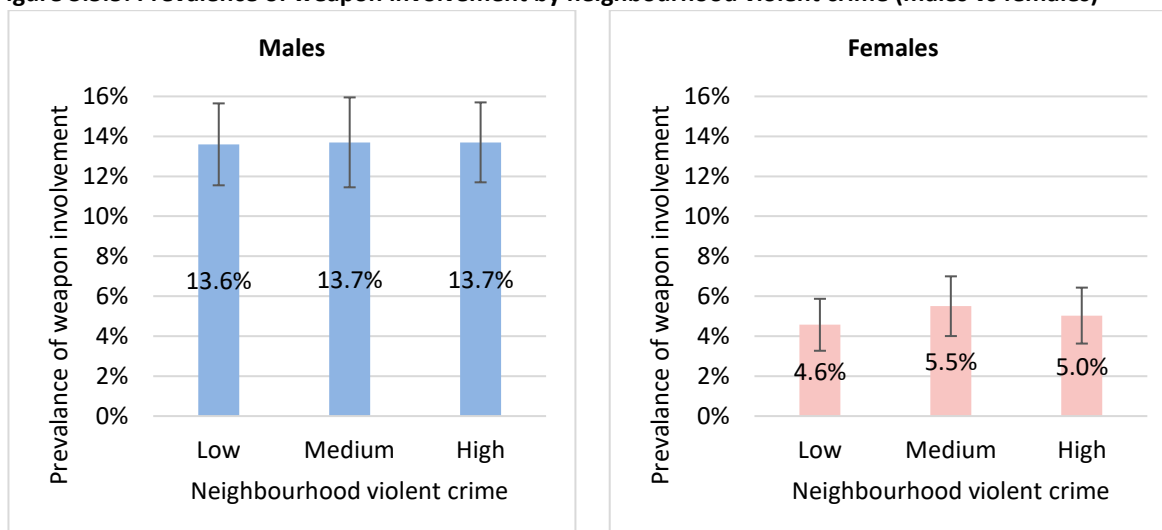
Notes: models adjust for ethnicity, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single, adverse childhood experiences and positive childhood experience. Capped lines indicate 95% confidence intervals.
Sample size N=14,088 (imputed sample). Males N=7,241, females N=6,847. Results weighted for survey design.

Table 3.5.5: Prevalence of weapon involvement by neighbourhood violent crime (males vs females)

	Males		Females		Gender difference (male)
	Prevalence	RR	Prevalence	RR	RR
Neighbourhood violent crime					
Low 0–33%	13.6%	Ref	4.6%	Ref	Ref
Medium 33–66%	13.7%	1.01	5.5%	1.20	0.82
High 66–100%	13.7%	1.01	5.0%	1.10	0.88

Notes: models adjust for ethnicity, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single, adverse childhood experiences and positive childhood experiences.
Gender differences were examined in an interaction model. *** p<0.001, ** p<0.01, * p<0.05, + p<0.10.
Sample size N=14,088 (imputed sample). Males N=7,241, females N=6,847. Results weighted for survey design. RR=risk ratio

Examination by ethnicity

Figure 3.5.6 and Table 3.5.6 show the examinations by groups, which overall show no statistically significant differences between those of White origin compared to those belonging to all other ethnic groups. Nevertheless, we do see a larger risk ratio coefficient for those of Black ethnic background, while for the Asian group, there is a reverse association between neighbourhood violent crime and weapon involvement.

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Figure 3.5.6: Prevalence of weapon involvement by neighbourhood violent crime (ethnic groups)

Note: Other ethnicity was a category with very small numbers (N=76), so to enable analyses to run and converge, this had to be dropped from the analyses. Models adjust for sex at birth, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single, adverse childhood experiences and positive childhood experiences. Capped lines indicate 95% confidence intervals. Sample size N=14,012 (imputed sample). Asian N=902, Black N=358, Mixed N=454, White N=12,299. Results weighted for survey design.

Table 3.5.6: Prevalence of weapon involvement by neighbourhood violent crime (ethnic groups)

| | Neighbourhood violent crime | | | | Ethnic differences |
	Low Prevalence	**Medium** Prevalence	**High** Prevalence	**High vs Low** RR	RR
White	9.7%	10.3%	10.0%	1.04	Ref
Mixed	10.7%	9.6%	10.6%	0.99	0.95
Asian	9.4%	7.4%	7.3%	0.78	0.75
Black	5.4%	9.3%	7.2%	1.32	1.33

Note: the Other ethnicity group had very small numbers (N=76), so to enable analyses to run and converge, this had to be dropped from the analyses. Models adjust for sex at birth, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single, adverse childhood experiences and positive childhood experiences. Ethnic differences were examined in an interaction model. *** p<0.001, ** p<0.01, * p<0.05, + p<0.10.
Sample size N=14,012 (imputed sample). Asian N=902, Black N=358, Mixed N=454, White N=12,299. Results weighted for survey design.
RR=risk ratio

Gang involvement

Results of the association between neighbourhood violent crime and young people's gang involvement are presented in Figure 3.5.7 and Table 3.5.7.

In Model 1, not accounting for any other variables, there are substantial differences in gang involvement by levels of neighbourhood violence. Those in the highest 80–100% most violent neighbourhoods had a prevalence of gang involvement of 9.7%, compared to 4.7% in neighbourhoods with the lowest 20% violence rates. This is a doubling of the risk of gang involvement (RR=2.06, p<.001).

Next, looking at Model 2, which controls for a range of individual and family factors, the association becomes non-significant, and we see that the prevalence of gang involvement is very equivalent across all levels of neighbourhood violence, with only a very minor elevated risk in neighbourhoods with the highest level of violent crime (7.1%) compared to those with the lowest level of neighbourhood violent crime (6.8%).

Figure 3.5.7: Prevalence of gang involvement by neighbourhood violent crime
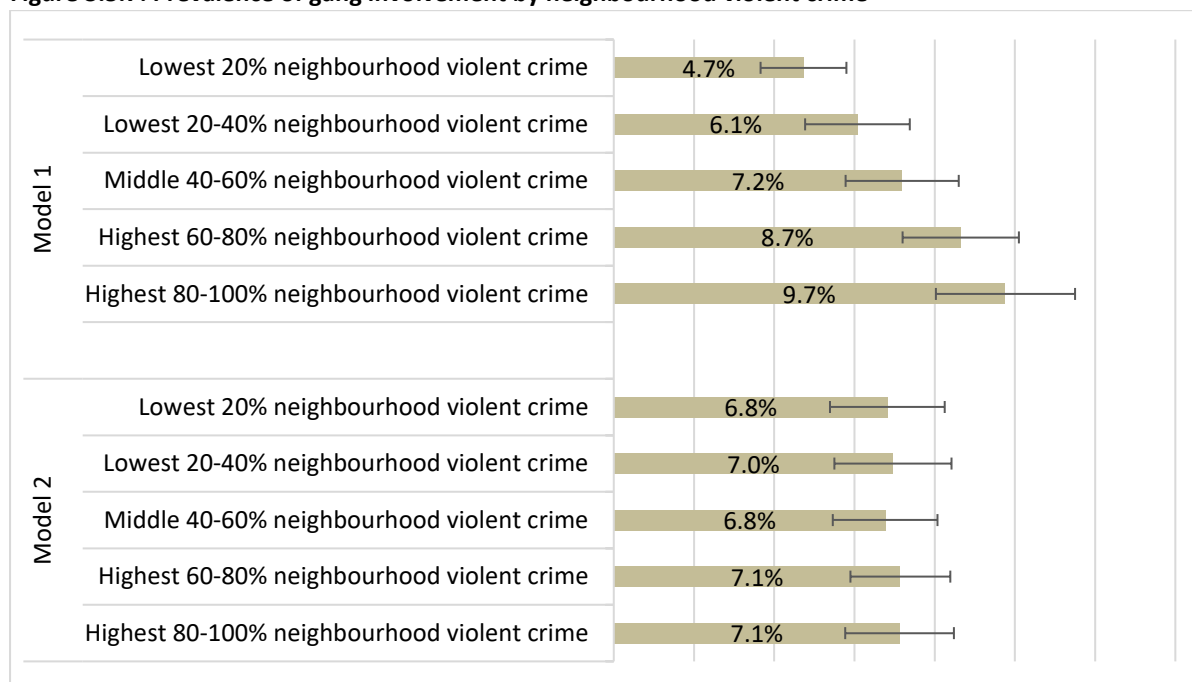
Notes: Model 1: not adjusted for any other variables. Model 2: adjusted for sex at birth, ethnicity, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single, adverse childhood exper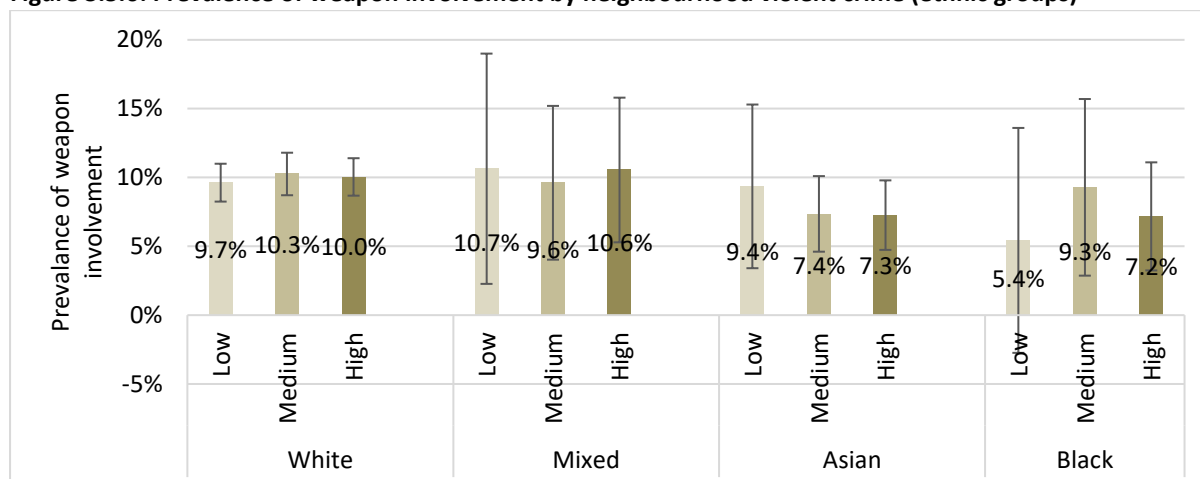iences and positive childhood experiences. Capped lines indicate 95% confidence intervals. Sample size N=14,088 (imputed sample). Results weighted for survey design.

Table 3.5.7: Risk ratio (RR) differences in gang involvement between neighbourhoods with varying levels of violent crime

	Model 1 (unadjusted)		Model 2 (adjusted)	
	Prevalence	RR	Prevalence	RR
Lowest 20% neighbourhood violent crime	4.7%	Ref	6.8%	Ref
Lowest 20–40% neighbourhood violent crime	6.1%	1.29	7.0%	1.02
Middle 40–60% neighbourhood violent crime	7.2%	1.52**	6.8%	0.99
Highest 60–80% neighbourhood violent crime	8.7%	1.83***	7.1%	1.05
Highest 80–100% neighbourhood violent crime	9.7%	2.06***	7.1%	1.05

Notes: Model 1: not adjusted for any other variables. Model 2: adjusted for sex at birth, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single, adverse childhood experiences and positive childhood experiences. *** p<0.001, ** p<0.01, * p<0.05, + p<0.10. Sample size N=14,088 (imputed sample). Results weighted for survey design.

Examination by gender

Examinations of the fully adjusted model are shown by gender in Figure 3.5.8 and Table 3.5.8. The association between neighbourhood violent crime and gang involvement is still non-significant for both males and females. However, for males, there is a slight incremental increase in gang involvement as levels of neighbourhood violent crime increase, but for females, the pattern is unclear, as the risk of gang involvement is slightly higher for those in medium violent crime areas than in both low and high violent crime areas, which have largely the same prevalence. These gender differences are not statistically significant.

Figure 3.5.8: Prevalence of gang involvement by neighbourhood violent crime (males vs females)
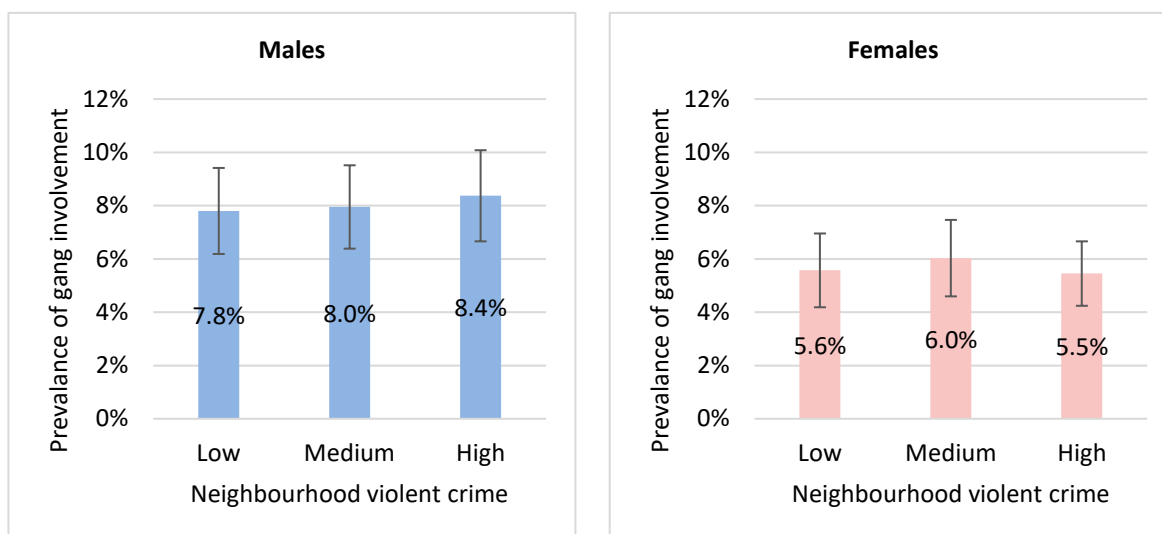
Notes: models adjust for ethnicity, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single, adverse childhood experiences and positive childhood experiences. Capped lines indicate 95% confidence intervals. Sample size N=14,088 (imputed sample). Males N=7,241, females N=6,847. Results weighted for survey design.

Table 3.5.8: Prevalence of gang involvement by neighbourhood violent crime (males vs females)

	Males		Females		Gender difference (male)
	Prevalence	RR	Prevalence	RR	RR
Neighbourhood violent crime					
Low 0–33%	7.8%	Ref	5.6%	Ref	Ref
Medium 33–66%	8.0%	1.02	6.0%	1.08	0.93
High 66–100%	8.4%	1.07	5.5%	0.98	1.07

Notes: models adjust for ethnicity, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single, adverse childhood experiences and positive childhood experiences. Gender differences were examined in an interaction model. *** p<0.001, ** p<0.01, * p<0.05, + p<0.10. Sample size N=14,088 (imputed sample). Males N=7,241, females N=6,847. Results weighted for survey design. RR=risk ratio

Examination by ethnicity

Ethnic differences are examined and reported in Figure 3.5.9 and Table 3.5.9. Those of Black ethnic background had to be dropped due to the analyses not converging when running the model. Results show no statistically significant differences when comparing those of White origin to other ethnic groups. However, it is noteworthy that the association was reversed for those of Asian and Mixed ethnicity, as the risk of gang involvement was highest in low-violence neighbourhoods.

Figure 3.5.9: Prevalence of gang involvement by neighbourhood violent crime (ethnic groups)
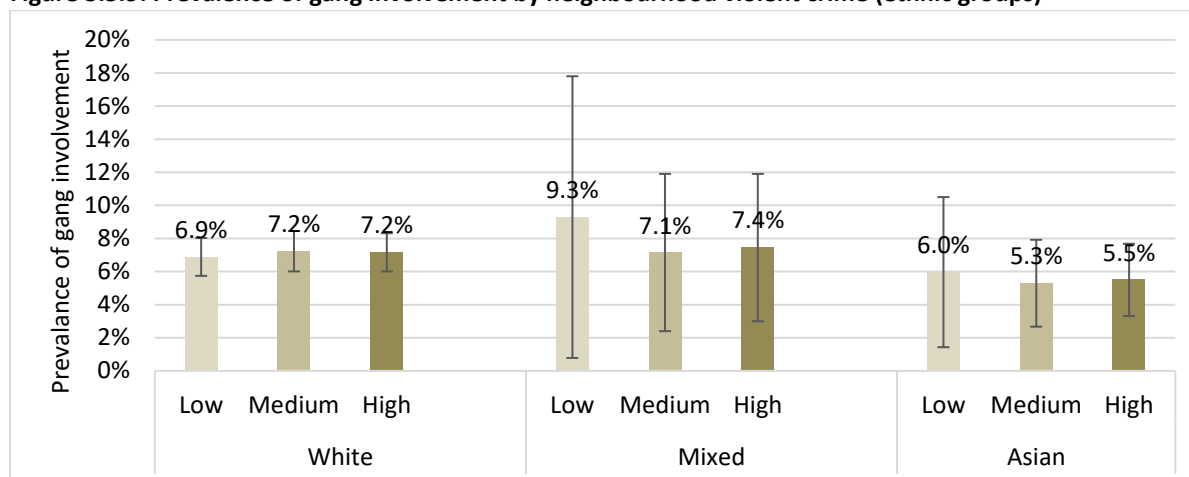
Note: Other ethnicity was a category with very small numbers (N=76), so to enable analyses to run and converge, this had to be dropped from the analyses. The Black ethnic group (N=358) was also omitted due to convergence problems. Models adjust for sex at birth, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single, adverse childhood experiences and positive childhood experiences. Capped lines indicate 95% confidence intervals.
Sample size N=13,654 (imputed sample). Asian N=902, Mixed N=454, White N=12,299. Results weighted for survey design.

Table 3.5.9: Prevalence of assault perpetration by neighbourhood violent crime (ethnic groups)

	Neighbourhood violent crime				Ethnic differences
	Low Prevalence	**Medium** Prevalence	**High** Prevalence	**High vs Low** RR	RR
White	6.9%	7.2%	7.2%	1.04	Ref
Mixed	9.3%	7.1%	7.4%	0.80	0.77
Asian	6.0%	5.3%	5.5%	0.92	0.90

Note: the Other ethnicity group had very small numbers (N=76), so to enable analyses to run and converge, this had to be dropped from the analyses. The Black ethnic group (N=358) was also omitted due to convergence problems. Models sex at birth, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single, adverse childhood experiences and positive childhood experiences. Ethnic differences were examined in an interaction model. *** p<0.001, ** p<0.01, * p<0.05, + p<0.10.
Sample size N=13,654 (imputed sample). Asian N=902, Mixed N=454, White N=12,299. Results weighted for survey design. RR=risk ratio

Additional analyses

A number of additional analyses were carried out, which are reported in the Appendix.

Neighbourhood deprivation as additional covariates

As a robustness check, four non-crime IMD domains common for England and Wales are added (income deprivation, employment deprivation, health deprivation, and education skills and training deprivation) as additional control variables (Model 3). This is to examine neighbourhood crime over and above general deprivation. These results are reported in the Appendix (assault perpetration: Figures A3.5.1 and Table A3.5.1, weapon involvement: Figure A3.5.2 and Table A3.5.2, and gang involvement: Figure A3.5.3 and Table A3.5.3). Findings show that including neighbourhood deprivation as a further control leads to only a very minor additional reduction in the association between neighbourhood violence and young people's engagement in assault perpetration, weapon involvement and gang involvement.

Examining measure of general neighbourhood crime

In examinations using the broader measure of general neighbourhood crime, results are almost identical to those for neighbourhood violent crime for all three youth violence outcomes (assault perpetration: Figure A3.5.4 and Table A3.5.4, weapon involvement: Figure A3.5.5 and Table A3.5.5 and gang involvement: Figure A3.5.6 and Table A3.5.6).

Examination using continuous measures of neighbourhood crime

Examinations using continuous measures of neighbourhood violent crime and neighbourhood general crime produce a similar pattern to the results of the main analyses using quintile measures (see Table A3.5.7).

Results using non-imputed data

Table A3.5.8 shows the results of examining the association between neighbourhood violent crime and youth violence using non-imputed data. Results are broadly similar to the main results using the larger imputed sample, with the unadjusted results showing risk ratios above 1, indicating that higher levels of neighbourhood violence are associated with higher levels of youth violence. However, unlike the main results, many of these associations are not statistically significant, especially for the less prevalent youth violence outcomes (weapon involvement and gang involvement). This lack of significance is likely due to the reduced statistical power in the much smaller sample sizes in the non-imputed data (assault perpetration N=6,901, weapon involvement N=4,865 and gang involvement N=4,930). As in the main results using imputed data, the association between neighbourhood violent crime and youth violence reduces substantially in the adjusted model with the full set of control variables. It is notable that in the non-imputed analyses, the associations reduce to such an extent that a reverse association is seen in some of the results (risk ratio below 1), although (apart from one single coefficient), these are not statistically significant, which is the same pattern observed in the main results using the imputed data.

Summary of results for RQ5: are rates of violent crime in one's neighbourhood associated with youth violence?

Overall, findings show that when unadjusted for covariates, there is an association between neighbourhood violence and all three youth outcomes, whereby engagement is higher for those living in a neighbourhood with high levels of violent crime. However, when controlling for a rich range of individual and family characteristics, including ACEs and PCEs during childhood, the association between neighbourhood violent crime and youth violence reduces dramatically and becomes statistically non-significant.

The results are contrary to our hypothesis that a higher level of violent crime in the neighbourhood would be associated with a higher likelihood of youth violence.

The results of the subgroup analyses showed that neighbourhood violent crime had a slightly larger association with assault perpetration for females than for males. For weapon involvement and gang involvement, there were no significant gender differences observed. Results of examinations by ethnicity were mixed, and none of these ethnic differences were significant statistically.

Interactions between neighbourhood crime and childhood experiences in relation to youth violence

Results for RQ6: does the association between adverse childhood experiences and youth violence differ for those in neighbourhoods with high versus low levels of violent crime?

The following shows the results of examining the association between ACEs and youth violence by level of neighbourhood violent crime. It addresses the question of whether the association between ACEs and youth violence differ between neighbourhoods with varying levels of violent crime.

Analyses will focus just on neighbourhood violent crime as the analyses for the previous RQ showed that neighbourhood general crime generate almost identical results. In the current analyses, the neighbourhood violent crime measure is transformed into tertiles: low 33%, medium 33–66% and high 66–100%. The reason for not using quintiles as in the previous analyses is that the current examinations use interactions with ACEs, and the quintile measures would result in many combinations of categories, which will reduce the statistical power of the analyses. For the same reason, the primary ACE measure used here is the binary measure that distinguishes between high (three or more) and low (zero to two) ACEs. This results in six combinations of categories between ACEs and neighbourhood violence.

The prevalence of youth violence is presented for each of these categories, fully adjusted for covariates. For each of the three levels of neighbourhood violent crime, the risk ratio is calculated by comparing those with a high level of ACEs in childhood to those with a low level of ACEs. In an additional step, an interaction model formally examines whether associations differ by levels of neighbourhood violent crime.

Because the categorisation of predictor variables can reduce statistical power, additional analyses examine the interaction between ACEs and the continuous measure of violent neighbourhood crime (z-scores) in predicting youth violence.

Assault perpetration

Figure 3.6.1 shows the prevalence of assault perpetration by high and low levels of ACEs and each of the three levels of neighbourhood violence (low, medium and high). We see that the results are very similar for each level of neighbourhood crime in terms of the difference in the prevalence of assault perpetration between those with low and high levels of ACEs. Looking at Table 3.6.1, which shows the corresponding risk ratio differences between those with high and low ACEs, we see that the coefficient is largely similar across neighbourhoods (low: RR=1.16, med: RR=1.13 and high: RR=1.13). Analyses that tested these risk ratio differences in an interaction model confirmed that there were no significant differences, nor was there any difference between neighbourhoods when examining neighbourhood violent crime as a continuous measure (see Appendix Table A3.6.1).

Figure 3.6.1: Prevalence of assault perpetration by adverse childhood experiences (ACEs) and levels of neighbourhood violent crime
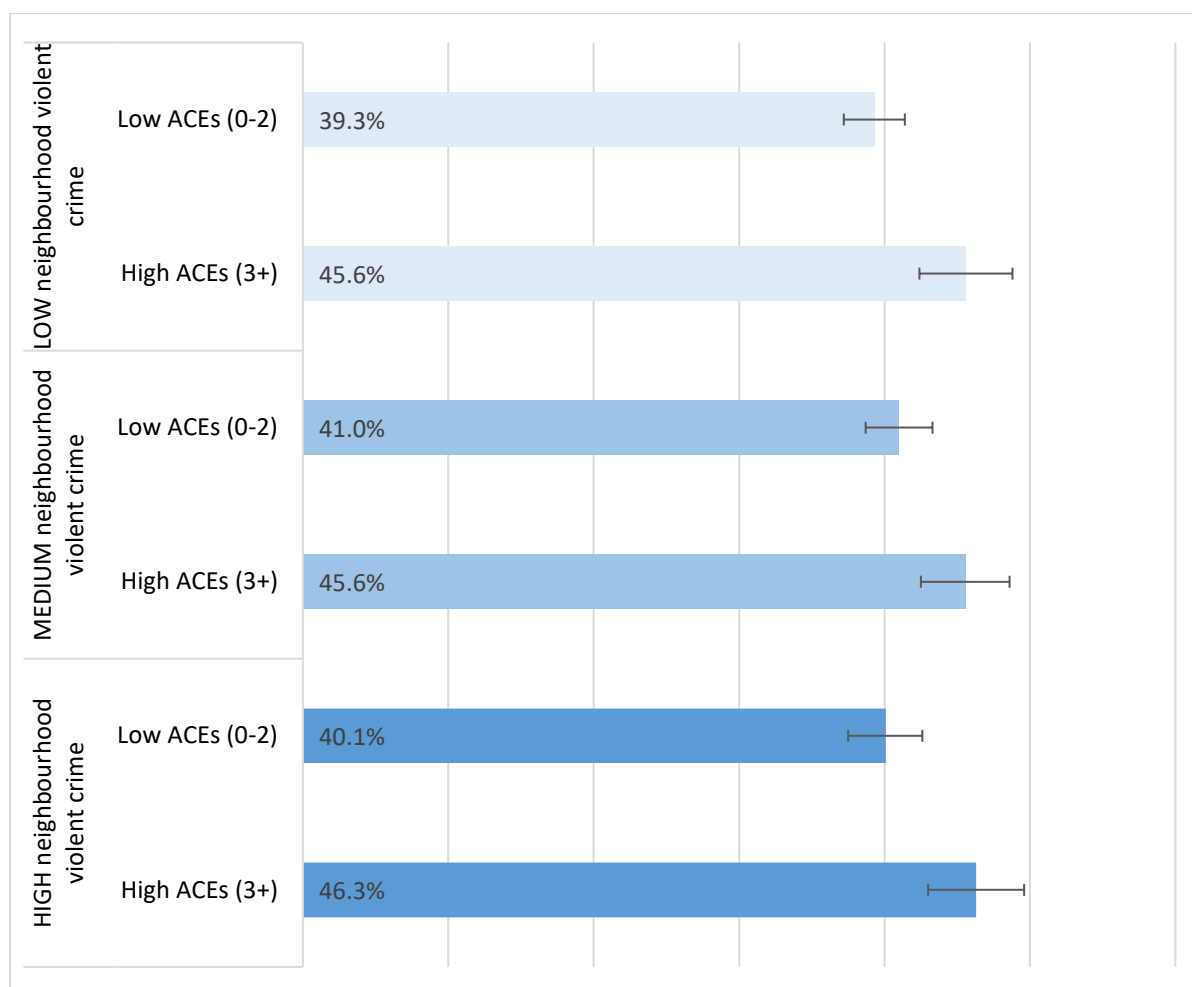
Notes: adjusted for sex at birth, ethnicity, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single and positive childhood experiences. Capped lines indicate 95% confidence intervals.
Sample size N=14,088 (imputed sample). Results weighted for survey design.

Table 3.6.1: Risk ratio (RR) differences in assault perpetration between high and low adverse childhood experiences (ACEs) by levels of neighbourhood violent crime

| | Neighbourhood violent crime | | | Differences | |
| | Low | Medium | High | Medium vs Low | High vs Low |
	RR	RR	RR	RR	RR
Low ACEs (0–2)	Ref	Ref	Ref	Ref	Ref
High ACEs (3+)	1.16**	1.13*	1.13*	0.95	0.99

Notes: adjusted for sex at birth, ethnicity, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single and positive childhood experiences. Neighbourhood differences were examined in an interaction model. *** $p<0.001$, ** $p<0.01$, * $p<0.05$, + $p<0.10$. Sample size N=14,088 (imputed sample). Results weighted for survey design.

Weapon involvement

The results of examining the association between ACEs and weapon involvement by three levels of neighbourhood violent crime are shown below. In Figure 3.6.2, we see that the

difference in the prevalence of weapon involvement between the high and low ACEs groups is similar for each level of neighbourhood violence. In Table 3.6.3, we see that the corresponding risk ratios are almost identical across neighbourhood groups (low: RR=1.45, med: RR=1.39 and high: RR=1.43). The interaction model confirmed that the level of neighbourhood violent crime did not significantly moderate the association between ACEs and weapon involvement, with a similar result when using a continuous measure of neighbourhood violence (see Appendix Table A3.6.1).

Figure 3.6.2: Prevalence of weapon involvement by adverse childhood experiences (ACEs) by levels of neighbourhood violent crime

Notes: adjusted for sex at birth, ethnicity, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single and positive childhood experiences. Capped lines indicate 95% confidence intervals. Sample size N=14,088 (imputed sample). Results weighted for survey design.

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Table 3.6.2: Risk ratio (RR) differences in weapon involvement between high and low adverse childhood experiences (ACEs) by levels of neighbourhood violent crime

| | Neighbourhood violent crime | | | Differences | |
	Low	Medium	High	Medium vs Low	High vs Low
	RR	RR	RR	RR	RR
Low ACEs (0–2)	Ref	Ref	Ref	Ref	Ref
High ACEs (3+)	1.45*	1.39**	1.43**	0.96	0.99

Notes: adjusted for sex at birth, ethnicity, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single and positive childhood experiences. Neighbourhood differences were examined in an interaction model. *** $p<0.001$, ** $p<0.01$, * $p<0.05$, + $p<0.10$. Sample size N=14,088 (imputed sample). Results weighted for survey design.

Gang involvement

The results of examining neighbourhood violent crime as a moderator of the association between ACEs and gang involvement are presented below. Figure 3.6.3 shows a broadly similar pattern for the neighbourhood violence groups in terms of the difference between those with high and low ACEs. The results are similar, especially for those with low and high levels of neighbourhood violence (RR=1.52 and RR=1.41), whereas for those in the middle group of neighbourhood violence, the difference in gang involvement between those with high and low ACEs was slightly smaller (RR=1.21). The interaction model indicated no significant difference between neighbourhood groups, and these interactions were also non-significant when examining the continuous measure of neighbourhood violence (see Appendix Table A3.6.1).

Figure 3.6.3: Prevalence of gang involvement by adverse childhood experiences (ACEs) by levels of neighbourhood violent crime
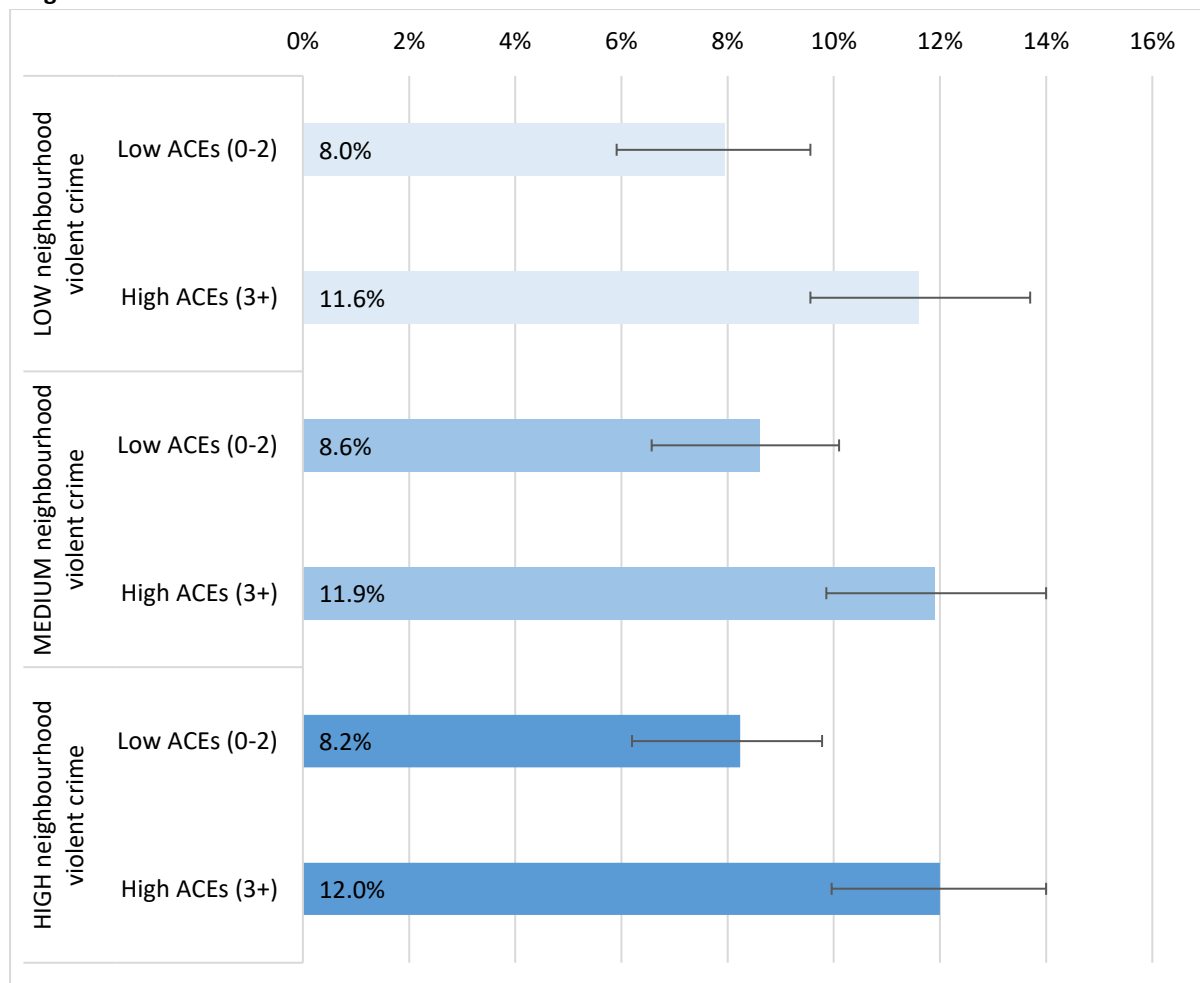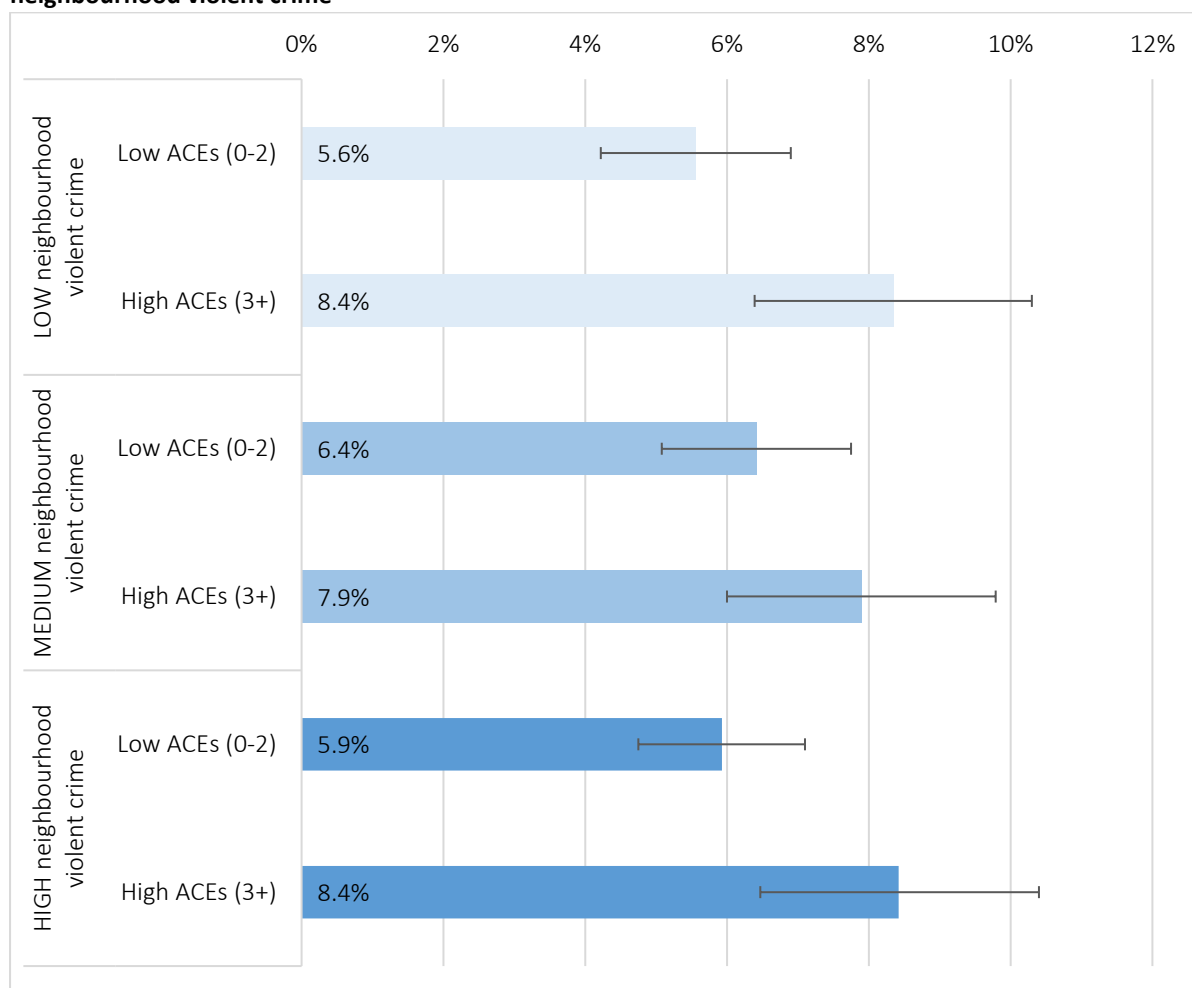

Notes: adjusted for sex at birth, ethnicity, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single and positive childhood experiences. Capped lines indicate 95% confidence intervals. Sample size N=14,088 (imputed sample). Results weighted for survey design.

Table 3.6.3 Risk ratio (RR) differences in gang involvement between high and low adverse childhood experiences (ACEs) by levels of neighbourhood violent crime

| | Neighbourhood violent crime | | | Difference | |
| | Low | Medium | High | Medium vs Low | High vs Low |
	RR	RR	RR	RR	RR
Low ACEs (0–2)	Ref	Ref	Ref	Ref	Ref
High ACEs (3+)	1.52*	1.21	1.41*	0.80	0.92

Notes: adjusted for sex at birth, ethnicity, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single and positive childhood experiences. Neighbourhood differences were examined in an interaction model. *** $p<0.001$, ** $p<0.01$, * $p<0.05$, + $p<0.10$. Sample size N=14,088 (imputed sample). Results weighted for survey design.

Summary of results for RQ6: does the association between adverse childhood experiences and youth violence differ for those in neighbourhoods with high versus low levels of violent crime?

To summarise the results, ACEs are associated with a higher risk of assault perpetration, weapon involvement and gang involvement regardless of the levels of violent crime in the

neighbourhoods in which young people grow up. Therefore, neighbourhood violence does not moderate the association between ACEs and youth violence. This is contrary to our pre-specified hypothesis, as we expected neighbourhood violence to be a potential additional risk factor and, therefore, that it would lead to a stronger association between ACEs and youth violence in neighbourhoods with high levels of violent crime compared to areas with lower levels.

Results for RQ7: does the association between positive childhood experiences and youth violence differ for those in neighbourhoods with high versus low levels of violent crime?

The results presented next are examinations of the association between PCEs and youth violence by different levels of neighbourhood violent crime. This addresses the question of whether PCEs are associated with youth violence differently in neighbourhoods with varying levels of violent crime.

The methodological approach is similar to the examinations of ACEs, where tertile measures of neighbourhood violence (low 33%, medium 33–66% and high 66–100%) are used along with a binary measure of PCEs that distinguishes between a high vs a low number of PCEs. Low PCEs were those with zero to four protective factors (mean=3.8), and high PCEs were five or more. This results in six combinations of categories between PCEs and neighbourhood violent crime.

Youth violence prevalences are calculated for each category, adjusting for covariates. Risk ratios between those with high levels of PCEs and those with low levels are calculated for each of the three levels of neighbourhood violence. If these risk ratios differ significantly, which is formally tested in interaction models, this indicates that neighbourhood violence may play a role in how effective PCEs are at reducing youth violence.

Additional analyses examine the interaction between PCEs and the continuous measure of violent neighbourhood crime (z-scores) in predicting youth violence. These analyses are undertaken to ensure that the categorisation used in the main analyses does not affect the results.

Assault perpetration

Results of examining the association between PCEs and assault perpetration by the three levels of neighbourhood violent crime are shown below. In Figure 3.7.1, the pattern of the prevalence of weapon involvement between high and low PCEs groups looks very similar for each level of neighbourhood violent crime. Further, in Table 3.7.1, we see that the corresponding risk ratios are nearly uniform across neighbourhoods (low: RR=0.79, med: RR=0.79 and high: RR=0.74). The interaction model confirmed that the level of neighbourhood violent crime does not significantly moderate the association between PCEs and assault perpetration, with a similar result if using a continuous measure of neighbourhood violent crime (see Appendix Table A3.7.1).

Figure 3.7.1: Prevalence of assault perpetration by positive childhood experiences (PCEs) by levels of neighbourhood violent crime
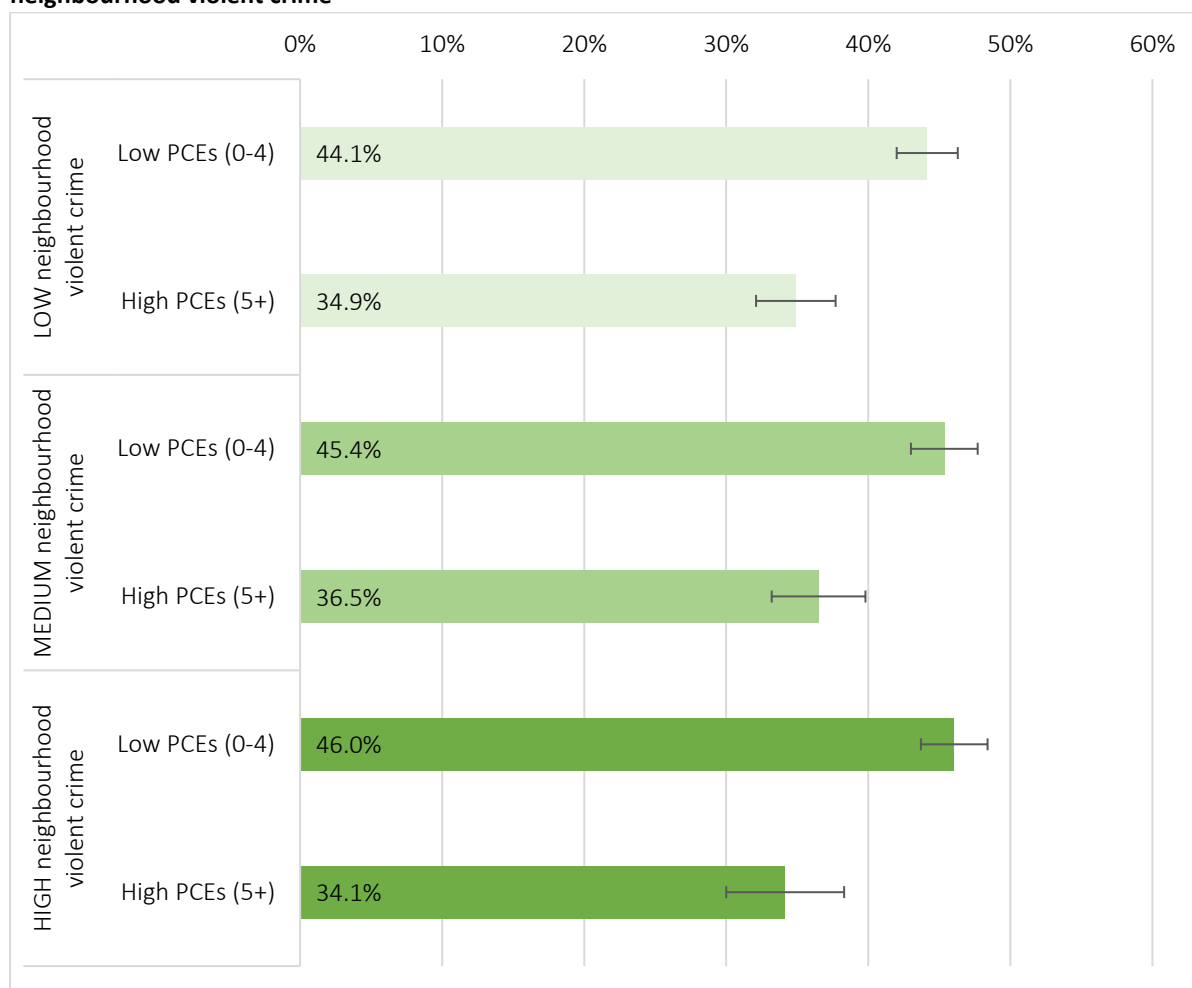
Notes: adjusted for sex at birth, ethnicity, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single and adverse childhood experiences. Capped lines indicate 95% confidence intervals. Sample size N=14,088 (imputed sample). Results weighted for survey design.

Table 3.7.1: Risk ratio (RR) differences in assault perpetration between high and low positive childhood experiences (PCEs) by levels of neighbourhood violent crime

| | Neighbourhood violent crime | | | Differences | |
| | Low | Medium | High | Medium vs Low | High vs Low |
	RR	RR	RR	RR	RR
Low PCEs (0–4)	Ref	Ref	Ref	Ref	Ref
High PCEs (5+)	0.79***	0.79***	0.74***	1.02	0.95

Notes: adjusted for sex at birth, ethnicity, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single and adverse childhood experiences. Neighbourhood difference was examined in an interaction model. *** p<0.001, ** p<0.01, * p<0.05, + p<0.10. Sample size N=14,088 (imputed sample). Results weighted for survey design.

Weapon involvement

Figure 3.7.2 shows the prevalence of assault perpetration by high and low levels of PCEs and each of the three levels of neighbourhood violence (low, medium and high). We see that the results are very similar for each level of neighbourhood crime in terms of the difference in the prevalence of assault perpetration between those with low and high levels of PCEs. Looking

at the corresponding risk ratio differences in Table 3.7.2, we see that the coefficients are largely similar across neighbourhoods (low: RR=0.54, med: RR=0.46 and high: RR=0.50). Analyses that tested these risk ratio differences in an interaction model confirmed that there were no significant differences. There were also no differences between neighbourhoods when examining neighbourhood violent crime as a continuous measure (see Appendix Table A3.7.1).

Figure 3.7.2: Prevalence of weapon involvement by positive childhood experiences (PCEs) by levels of neighbourhood violent crime
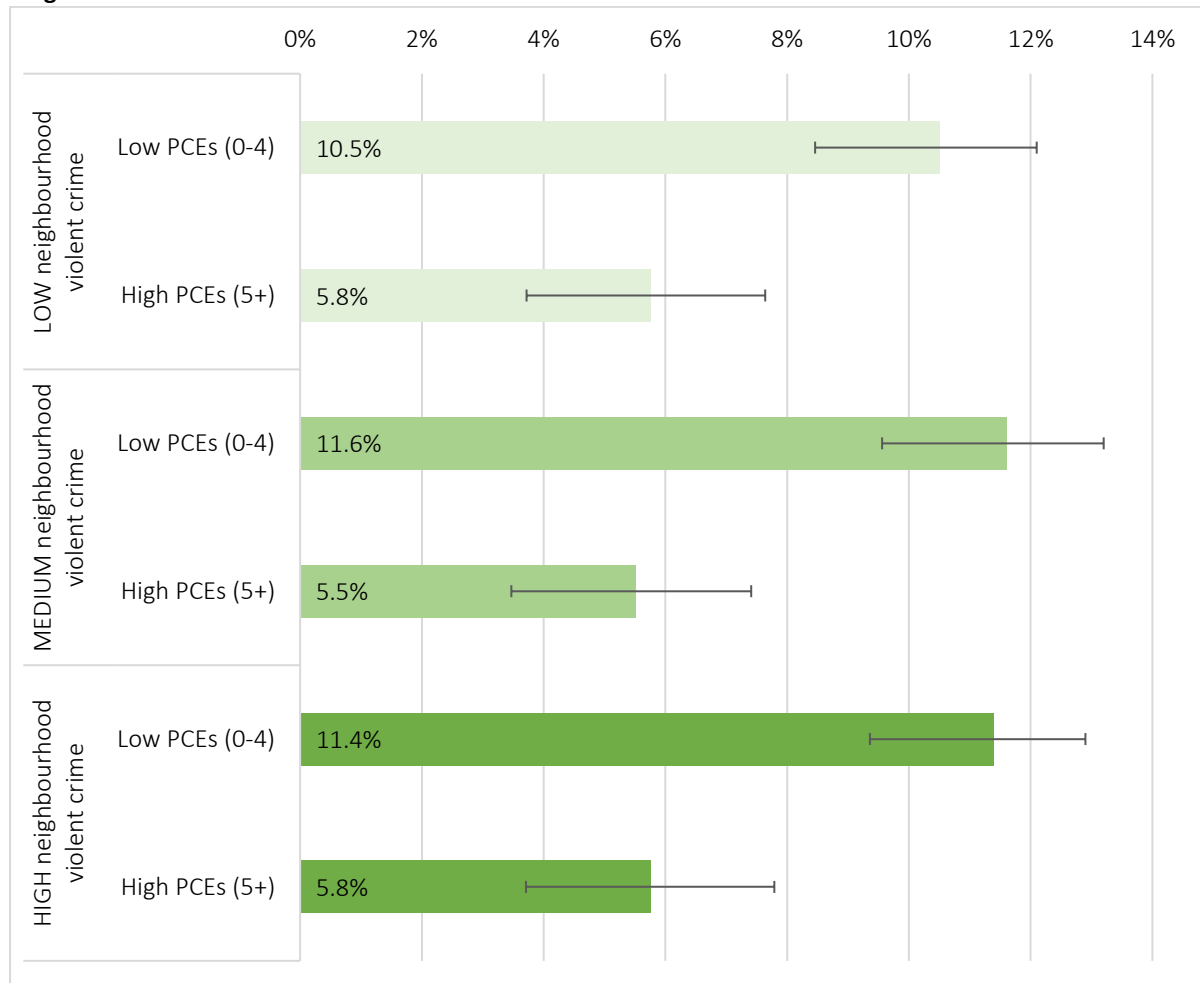
Notes: adjusted for sex at birth, ethnicity, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single and adverse childhood experiences. Capped lines indicate 95% confidence intervals.
Sample size N=14,088 (imputed sample). Results weighted for survey design.

Table 3.7.2: Risk ratio (RR) differences in weapon involvement between high and low positive childhood experiences (PCEs) by levels of neighbourhood violent crime

	Neighbourhood violent crime			Differences	
	Low	**Medium**	**High**	**Medium vs Low**	**High vs low**
	RR	RR	RR	RR	RR
Low PCEs (0–4)	Ref	Ref	Ref	Ref	Ref
High PCEs (5+)	0.54**	0.46***	0.50***	0.81	0.87

Notes: adjusted for sex at birth, ethnicity, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single and adverse childhood experiences. Neighbourhood differences were examined in an interaction model. *** $p<0.001$, ** $p<0.01$, * $p<0.05$, + $p<0.10$. Sample size N=14,088 (imputed sample). Results weighted for survey design.

Gang involvement

The results of examining neighbourhood violent crime as a moderator of the association between PCEs and gang involvement are presented below. Figure 3.7.3 shows the prevalence of gang involvement for those with high and low PCEs in the three levels of neighbourhood violent crime. Table 3.7.3 shows the corresponding risk ratios between high and low PCEs in neighbourhoods with high (RR=0.61), medium (RR=0.56) and low (RR=0.71) levels of violent crime. Despite some variation, the interaction model indicated no significant difference between neighbourhoods. These interactions were also not significant in examinations using the continuous measure of neighbourhood violence (see Appendix Table A3.7.1).

Figure 3.7.3: Prevalence of gang involvement by positive childhood experiences (PCEs) and levels of neighbourhood violent crime
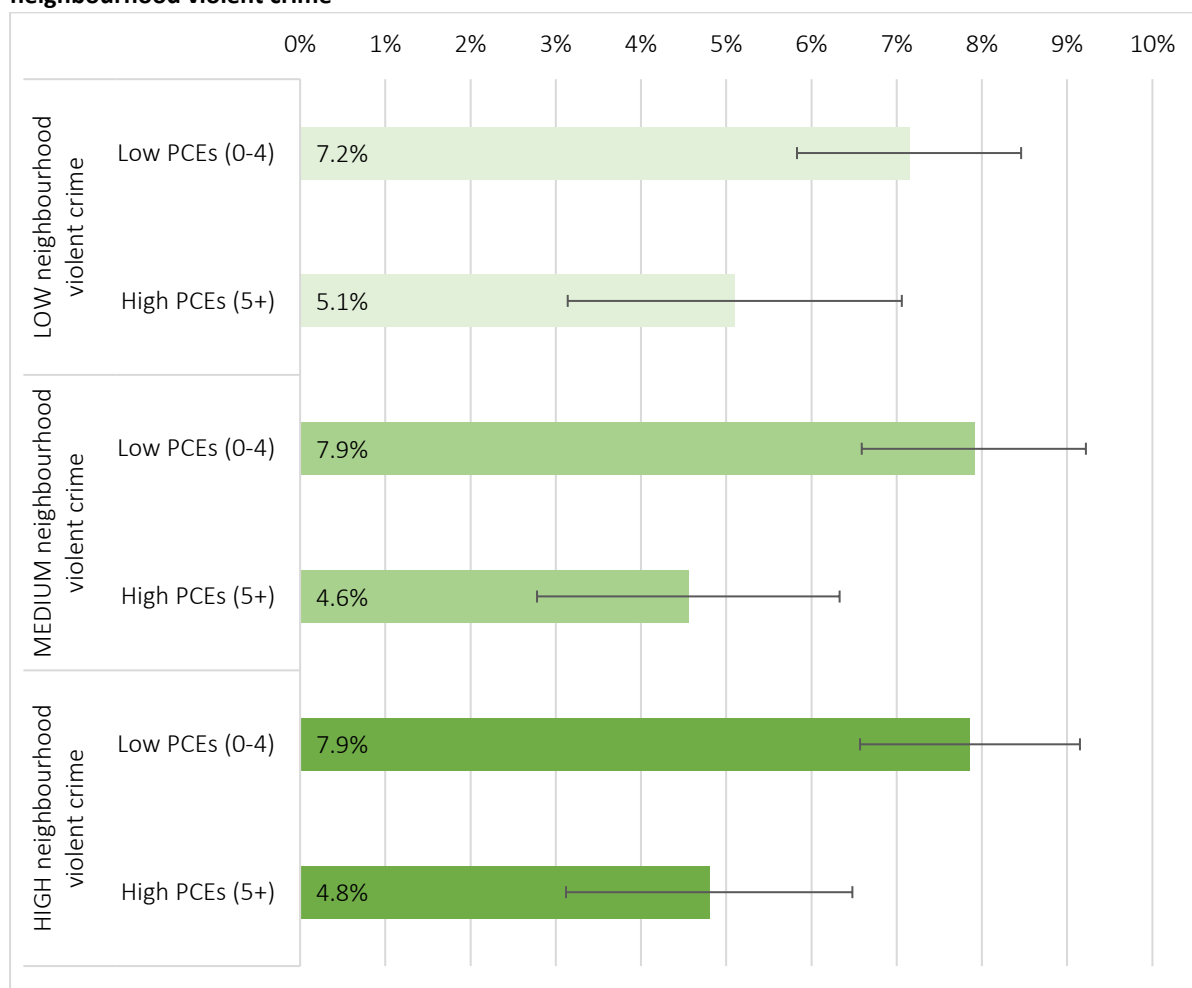
Notes: adjusted for sex at birth, ethnicity, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single and adverse childhood experiences. Capped lines indicate 95% confidence intervals.
Sample size N=14,088 (imputed sample). Results weighted for survey design.

Table 3.7.3: Risk ratio (RR) differences in gang involvement between high and low positive childhood experiences (PCEs) by levels of neighbourhood violent crime

| | Neighbourhood violent crime | | | Differences | |
| | Low | Medium | High | Medium vs Low | High vs low |
	RR	RR	RR	RR	RR
Low PCEs (0–4)	Ref	Ref	Ref	Ref	Ref
High PCEs (5+)	0.71	0.56**	0.61*	0.87	0.94

Notes: adjusted for sex at birth, ethnicity, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single and adverse childhood experiences. Neighbourhood difference was examined in an interaction model. *** p<0.001, ** p<0.01, * p<0.05, + p<0.10. Sample size N=14,088 (imputed sample). Results weighted for survey design.

Summary of results for RQ7: does the association between positive childhood experiences and youth violence differ for those in neighbourhoods with high versus low levels of violent crime?

In conclusion, the results show that the protective association of PCEs against assault perpetration, weapon involvement and gang involvement is uniform across neighbourhoods

with different levels of violent crime. Therefore, neighbourhood violent crime does not appear to significantly moderate the association between PCEs and any of the youth violence outcomes. These findings are inconsistent with our hypothesis, which stated that the association between PCEs and youth violence would be weaker in neighbourhoods with a high level of violent crime because neighbourhood violent crime was assumed to be a risk factor that would undermine the protectiveness of PCEs against youth violence.

Results for RQ8: do positive childhood experiences attenuate the association between adverse childhood experiences and youth violence more in low-crime areas or high-crime areas?

This section presents the results of examinations of whether the protective effect of PCEs against ACEs differs between neighbourhoods with low vs high levels of neighbourhood crime.

In these analyses, we replicate analyses carried out for RQ3 that examined whether PCEs attenuate the association between ACEs and youth violence, but we here add the level of neighbourhood violence as an additional moderator. We use the tertiary measure of neighbourhood violence: low 33%, medium 33–66% and high 66–100% and the binary measures of ACEs and PCEs to reduce the number of interacting categories.

Assault perpetration

Figure 3.8.1 and Table 3.8.1 show results for assault perpetration. The figure illustrates a broadly similar pattern across all three levels of neighbourhood crime, whereby those with a high level of ACEs have a significantly lower risk of assault perpetration in the presence of a high level of PCEs compared to those with a low level of PCEs. In the table, we see that the risk ratio is marginally lower in high-violence neighbourhoods compared to low-violence areas (low: RR=.81, med: RR=0.76 and high: RR=0.74), meaning that PCEs may protect against ACEs slightly more in neighbourhoods with a high level of violent crime. However, the results of the interaction model suggest that these neighbourhood differences are not statistically significant.

Figure 3.8.1: Prevalence of assault perpetration by high and low positive childhood experiences (PCEs) and level of adverse childhood experiences (ACEs) for neighbourhoods with different levels of violent crime
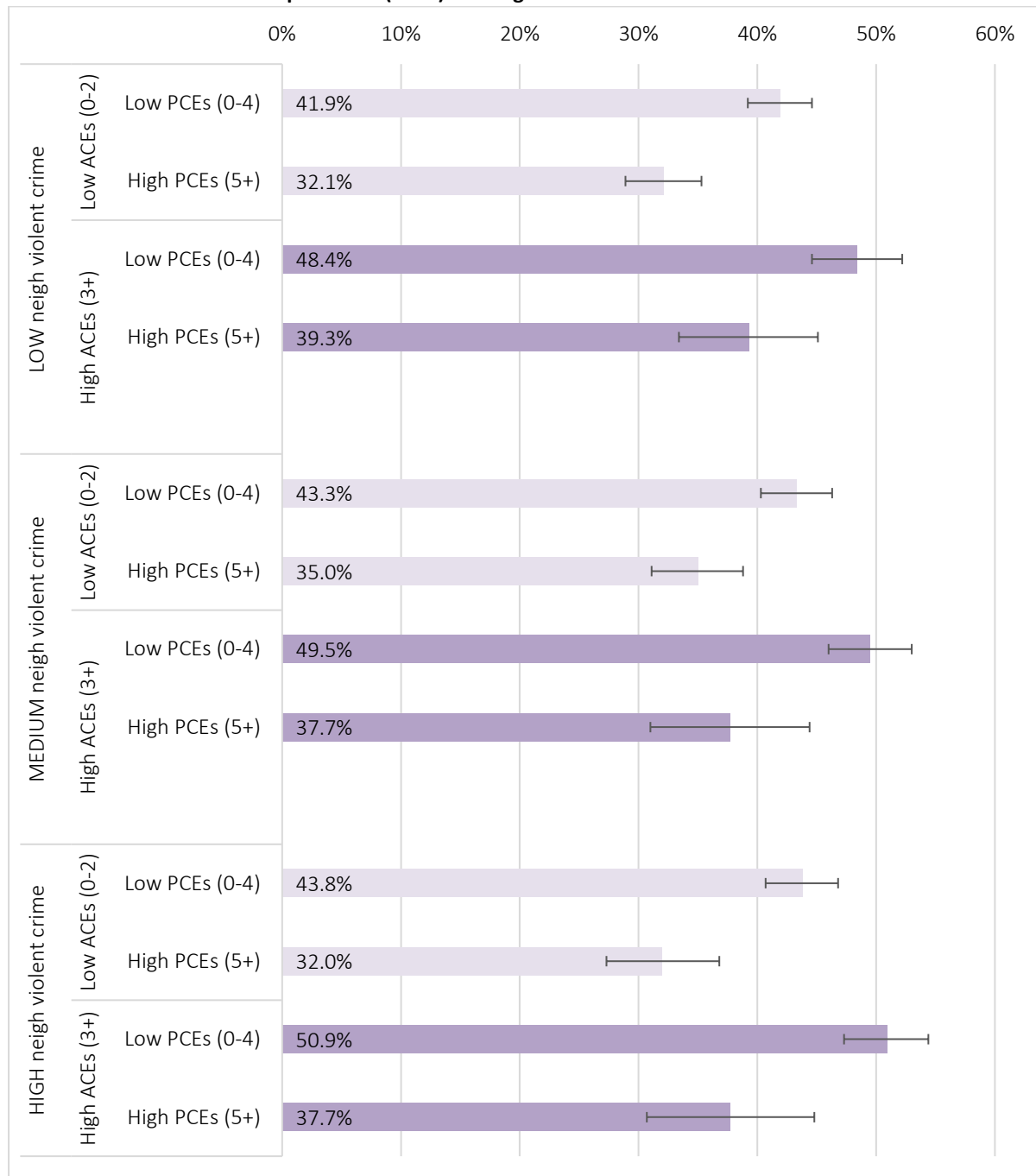
Notes: adjusted for sex at birth, ethnicity, maternal age at birth, income, education, occupational status and the number of sweeps parent was single. Capped lines indicate 95% confidence intervals.

Sample size N=14,088 (imputed sample). Results weighted for survey design.

Table 3.8.1: Risk ratio (RR) differences in assault perpetration between high and low positive childhood experiences (PCEs) and level of adverse childhood experiences (ACEs) for neighbourhoods with different levels of violent crime

		Neighbourhood violent crime			Differences	
		Low	Medium	High	Medium vs Low	High vs Low
		RR	RR	RR	RR	RR
Low ACEs (0–2)	Low PCEs (0–4)	0.87*	0.87**	0.86*	1.00	0.99
	High PCEs (5+)	0.66***	0.71***	0.63***	1.08	0.95
High ACEs (3+)	Low PCEs (0–4)	Ref	Ref	Ref	Ref	Ref
	High PCEs (5+)	0.81*	0.76**	0.74**	0.94	0.91

Notes: adjusted for sex at birth, ethnicity, maternal age at birth, income, education, occupational status and the number of sweeps parent was single. Neighbourhood difference was examined in an interaction model. *** p<0.001, ** p<0.01, * p<0.05, + p<0.10. Sample size N=14,088 (imputed sample). Results weighted for survey design.

Weapon involvement

Findings for weapon involvement are shown in Figure 3.8.2 and Table 3.8.2. Visually, the results look comparable between levels of neighbourhood violent crime, with a high level of PCEs being associated with a reduction in the prevalence of weapon involvement for those with a high level of ACEs. The risk ratios confirm similar results across neighbourhoods (low: RR=0.54, med: RR=0.47 and high: RR=0.52). The interaction model that formally tested differences between neighbourhoods confirmed that there were no significant differences.

Figure 3.8.2: Prevalence of weapon involvement by high and low positive childhood experiences (PCEs) and level of adverse childhood experiences (ACEs) for neighbourhoods with different levels of violent crime
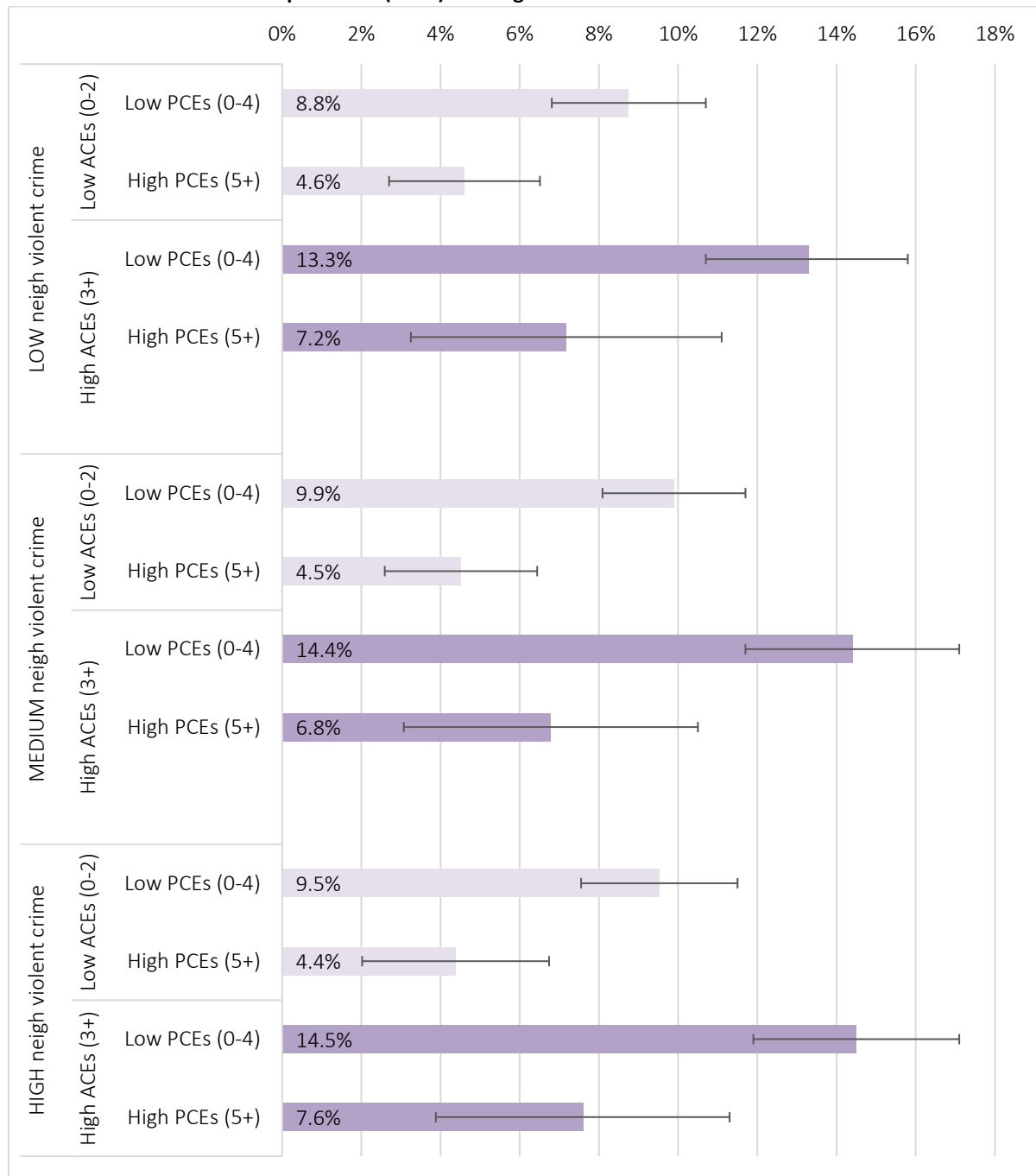
Notes: adjusted for sex at birth, ethnicity, maternal age at birth, income, education, occupational status and the number of sweeps parent was single. Capped lines indicate 95% confidence intervals.

Sample size N=14,088 (imputed sample). Results weighted for survey design.

Table 3.8.2: Risk ratio (RR) differences in weapon involvement between high and low positive childhood experiences and level of adverse childhood experiences (ACEs) for neighbourhoods with different levels of violent crime

| | | Neighbourhood violent crime | | | Differences | |
| | | Low | Medium | High | Medium vs Low | High vs Low |
		RR	RR	RR	RR	RR
Low ACEs (0–2)	Low PCEs (0–4)	0.66*	0.69**	0.66**	1.05	1.01
	High PCEs (5+)	0.35***	0.31***	0.30***	0.89	0.86
High ACEs (3+)	Low PCEs (0–4)	Ref	Ref	Ref	Ref	Ref
	High PCEs (5+)	0.54*	0.47*	0.52*	0.87	0.96

Notes: adjusted for sex at birth, ethnicity, maternal age at birth, income, education, occupational status and the number of sweeps parent was single. Neighbourhood difference was examined in an interaction model. *** $p<0.001$, ** $p<0.01$, * $p<0.05$, + $p<0.10$.
Sample size N=14,088 (imputed sample). Results weighted for survey design.

Gang involvement

Results for gang involvement are presented in Table 3.8.3 and Figure 3.8.3. Again, we visually see a broadly similar pattern across all levels of neighbourhood violent crime, whereby gang involvement is reduced for those with a high level of ACEs when combined with a high level of PCEs, compared to having high ACEs and a low level of PCEs. The risk ratios appear slightly lower in neighbourhoods with medium and high levels of violent crime, suggesting a larger protective association of PCEs against ACEs in these areas (low: RR=0.70, med: RR=0.56 and high: RR=0.57). However, these differences were not statistically significant, as indicated in the results of the interaction model.

Figure 3.8.3: Prevalence of gang involvement by high and low positive childhood experiences (PCEs) and level of adverse childhood experiences (ACEs) for neighbourhoods with different levels of violent crime

Notes: adjusted for sex at birth, ethnicity, maternal age at birth, income, education, occupational status and the number of sweeps parent was single. Capped lines indicate 95% confidence intervals.

Sample size N=14,088 (imputed sample). Results weighted for survey design.

Table 3.8.3: Risk ratio (RR) differences in gang involvement between high and low positive childhood experiences (PCEs) and the level of adverse childhood experiences (ACEs) for neighbourhoods with different levels of violent crime

		Neighbourhood violent crime			Differences	
		Low	Medium	High	Medium vs Low	High vs Low
		RR	RR	RR	RR	RR
Low ACEs (0–2)	Low PCEs (0–4)	0.63*	0.79	0.66*	1.25	1.05
	High PCEs (5+)	0.44*	0.43**	0.41**	0.98	0.93
High ACEs (3+)	Low PCEs (0–4)	Ref	Ref	Ref	Ref	Ref
	High PCEs (5+)	0.70	0.56+	0.57*	0.80	0.81

Notes: adjusted for sex at birth, ethnicity, maternal age at birth, income, education, occupational status and the number of sweeps parent was single. Neighbourhood difference was examined in an interaction model. *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$, + $p < 0.10$. Sample size N=14,088 (imputed sample). Results weighted for survey design.

Summary of results for RQ8: do positive childhood experiences attenuate the association between adverse childhood experiences and youth violence more in low-crime areas or high-crime areas?

Examinations showed that although PCEs attenuate the association between ACEs and assault perpetration and gang involvement slightly more in neighbourhoods with high levels of crime compared to low levels of crime, these differences were very small and non-significant. Therefore, the results do not support the pre-stated hypothesis that the attenuation would be lower in neighbourhoods with high levels of violent crime, based on the assumption that neighbourhood violent crime would be a potential added risk factor.

Results for RQ9: do adverse childhood experiences amplify the association between neighbourhood violent crime and youth violence?

The following results address the question of whether ACEs modify the association between neighbourhood violent crime and youth violence.

The approach taken was to examine neighbourhood violent crime as quintiles (lowest 20%, lowest 20–40%, middle 40–60%, highest 60–80% and highest 80–100%), and ACEs were examined as a binary variable: low (zero to two) vs high (three or more). All models include the full set of control variables.

Assault perpetration

Results for assault perpetration are shown in Figure 3.9.1 and Table 3.9.1. We see that for both high and low ACEs, there is a very small and non-significant difference between the prevalence of assault perpetration in those in the lowest 20% violent neighbourhoods compared to those in the neighbourhoods with the highest 80–100% violent crime. This is consistent with the main results reported for RQ5. Looking at the risk ratios comparing the low neighbourhood violence group to neighbourhoods with a higher level of violence, these are marginally larger in the high ACEs group. This suggests a slightly stronger association between neighbourhood violent crime and assault perpetration for those with high levels of ACEs. However, these differences are not statistically significant, as indicated in the results of the interaction model reported in the last column of the figure.

Figure 3.9.1: Prevalence of assault perpetration by neighbourhood violent crime by high and low adverse childhood experiences (ACEs)
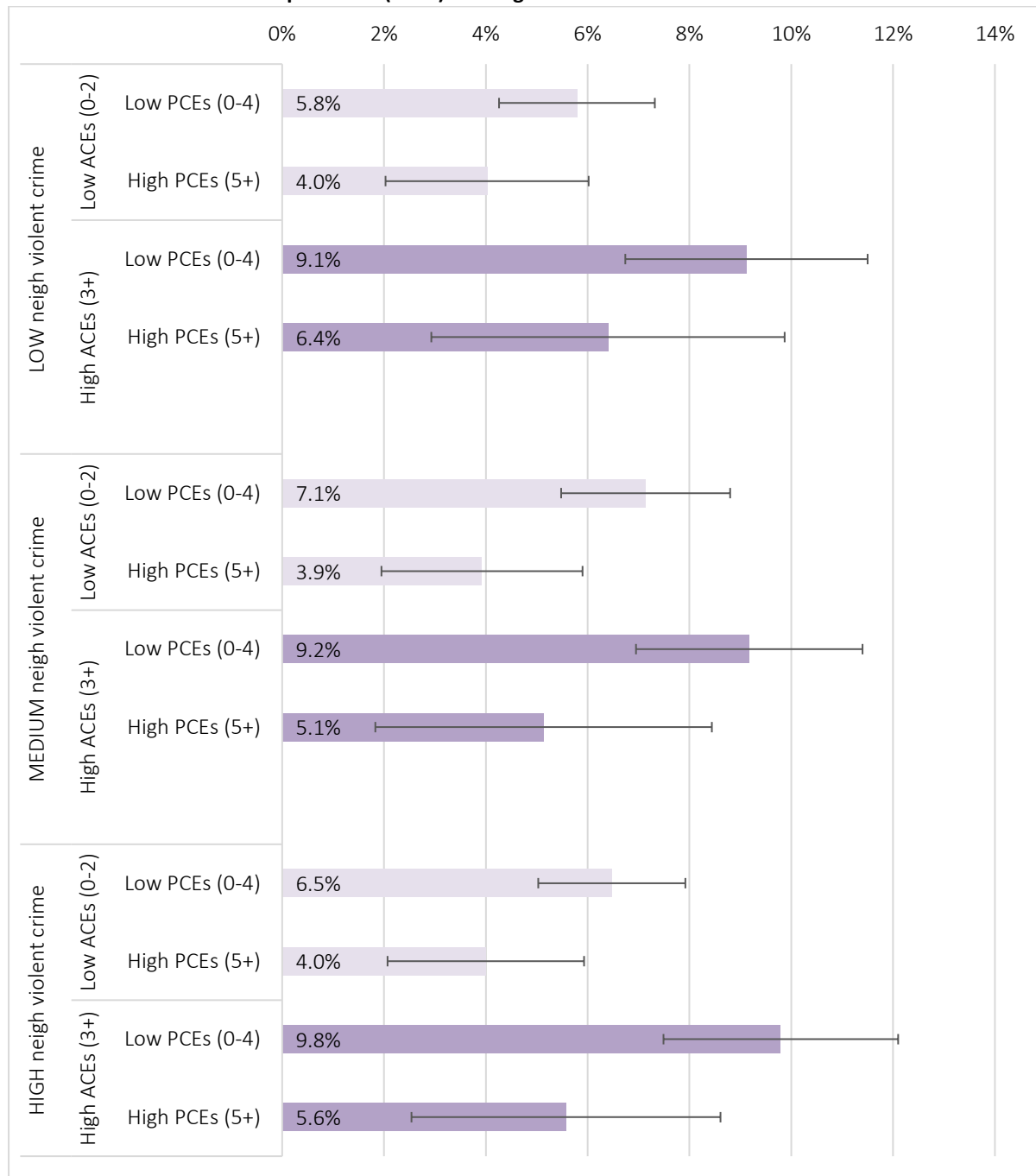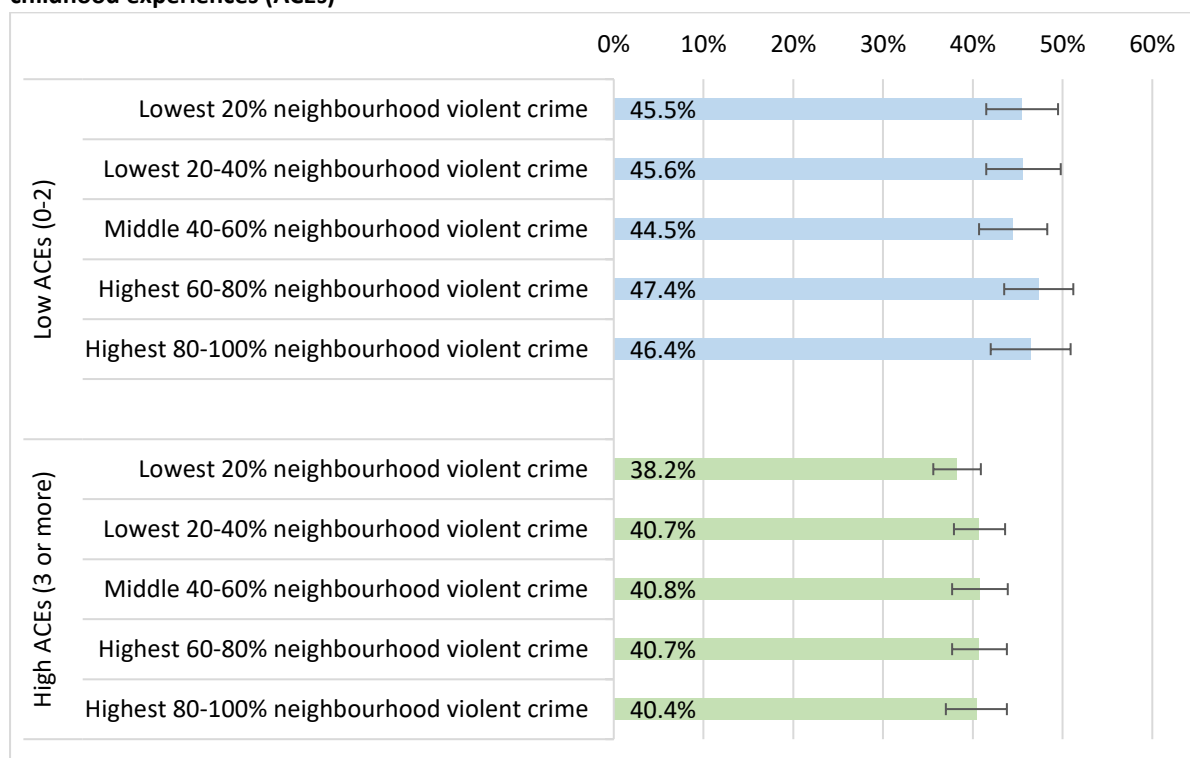

Notes: adjusted for sex at birth, ethnicity, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single and positive childhood experiences. Capped lines indicate 95% confidence intervals.
Sample size N=14,088 (imputed sample). Results weighted for survey design.

Table 3.9.1: Risk ratio (RR) differences in assault perpetration between neighbourhoods with low and higher levels of violent crime by low and high levels of adverse childhood experiences (ACEs)

	Low ACEs (0-2)	High ACEs (3 or more)	Difference (high vs low ACEs)
	RR	RR	RR
Lowest 20% neighbourhood violent crime	Ref	Ref	Ref
Lowest 20–40% neighbourhood violent crime	1.00	1.07	1.07
Middle 40–60% neighbourhood violent crime	0.98	1.07	1.09
Highest 60–80% neighbourhood violent crime	1.04	1.07	1.03
Highest 80–100% neighbourhood violent crime	1.02	1.06	1.04

Notes: adjusted for sex at birth, ethnicity, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single and positive childhood experiences. Differences between high and low ACEs was examined in an interaction model.
*** p<0.001, ** p<0.01, * p<0.05, + p<0.10.
Sample size N=14,088 (imputed sample). Results weighted for survey design.

Weapon involvement

Figure 3.9.2 and Table 3.9.2 show the results of the association between neighbourhood violent crime and weapon involvement by the level of ACEs in childhood. The overlapping confidence intervals between all levels of neighbourhood violent crime, seen for both low and high ACEs, indicate that there are no significant differences in weapon involvement between neighbourhoods. It is nevertheless notable that most of the risk ratios are below 1 for those

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with high ACEs, suggesting that neighbourhood violent crime has a reductive association with weapon involvement, while for low ACEs, the risk ratios are above 1, suggesting that increased neighbourhood violence is associated with an increase in the risk of weapon involvement. However, statistically, this pattern is not significant, and there are also no significant differences between the low and high ACEs groups, as seen from the results of the interaction model.

Figure 3.9.2: Prevalence of weapon involvement by neighbourhood violent crime by high and low adverse childhood experiences (ACEs)

Notes: adjusted for sex at birth, ethnicity, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single and positive childhood experiences. Capped lines indicate 95% confidence intervals. Sample size N=14,088 (imputed sample). Results weighted for survey design.

Table 3.9.2: Risk ratio (RR) differences in weapon involvement between neighbourhoods with low and higher levels of violent crime by low and high levels of adverse childhood experiences (ACEs)

	Low ACEs (0–2)	High ACEs (3 or more)	Difference (high vs low ACEs)
	RR	RR	RR
Lowest 20% neighbourhood violent crime	Ref	Ref	Ref
Lowest 20–40% neighbourhood violent crime	1.09	0.93	0.85
Middle 40–60% neighbourhood violent crime	1.18	0.92	0.78
Highest 60–80% neighbourhood violent crime	1.01	0.89	0.88
Highest 80–100% neighbourhood violent crime	1.11	1.02	0.92

Notes: adjusted for sex at birth, ethnicity, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single and positive childhood experiences. Differences between high and low ACEs were examined in an interaction model.
*** p<0.001, ** p<0.01, * p<0.05, + p<0.10. Sample size N=14,088 (imputed sample). Results weighted for survey design.

Gang involvement

Figure 3.9.3 and Table 3.9.3 present the results of the examination of the association between neighbourhood violent crime and gang involvement for those with high and low levels of ACEs. It is noticeable that risk ratios are all above 1 in the low ACEs group, suggesting an increase in gang involvement in neighbourhoods with higher levels of violent crime compared to neighbourhoods with the lowest 20% levels, while for those with high ACEs, the risk ratios are all below 1, suggesting that the risk of gang involvement is lower in neighbourhoods with higher levels of violent crime. However, this pattern is not statistically significant within each of these ACEs groups, and there is also no significant difference between the high and low ACEs groups, as seen in the interaction results. We note that a lack of statistical power may contribute to the lack of difference between groups.

Figure 3.9.3: Prevalence of gang involvement by neighbourhood violent crime by high and low adverse childhood experiences (ACEs)

Notes: adjusted for sex at birth, ethnicity, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single and positive childhood experiences. Capped lines indicate 95% confidence intervals. Sample size N=14,088 (imputed sample). Results weighted for survey design.

Table 3.9.3: Risk ratio (RR) differences in gang involvement between neighbourhoods with low and higher levels of violent crime by low and high levels of adverse childhood experiences (ACEs)

	Low ACEs (0–2)	High ACEs (3 or more)	Difference (high vs low ACEs)
	RR	RR	RR
Lowest 20% neighbourhood violent crime	Ref	Ref	Ref
Lowest 20–40% neighbourhood violent crime	1.23	0.84	0.68
Middle 40–60% neighbourhood violent crime	1.21	0.82	0.68

Highest 60–80% neighbourhood violent crime	1.09	0.98	0.90
Highest 80–100% neighbourhood violent crime	1.19	0.91	0.76

Notes: adjusted for sex at birth, ethnicity, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single and positive childhood experiences. Differences between high and low ACEs were examined in an interaction model.

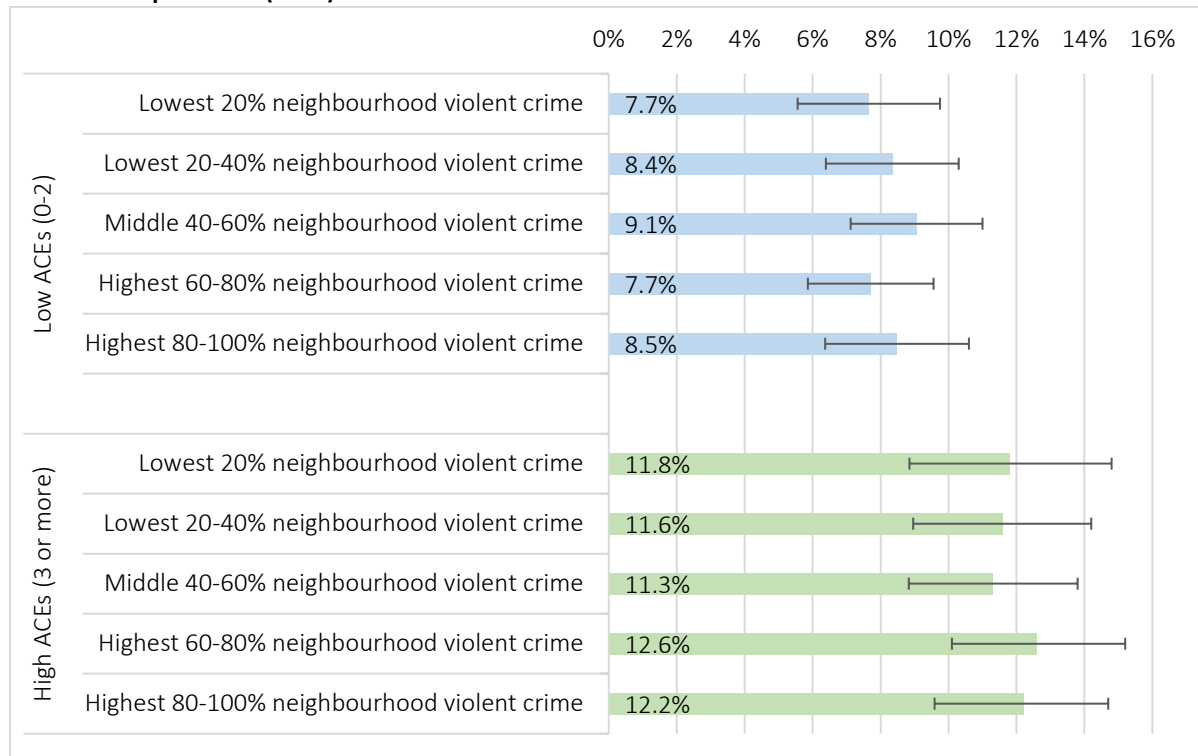*** $p<0.001$, ** $p<0.01$, * $p<0.05$, + $p<0.10$.

Sample size N=14,088 (imputed sample). Results weighted for survey design.

Summary of results for RQ9: do adverse childhood experiences amplify the association between neighbourhood violent crime and youth violence?

The results of the examinations show that the number of ACEs that children are exposed to during childhood does not significantly amplify the association between neighbourhood violent crime and youth violence. Overall, the findings do not support our hypothesis set out at the beginning of the study that neighbourhood violent crime will have a stronger association with youth violence for those with a high level of ACEs due to ACEs being an additional risk factor.

Results for RQ10: do positive childhood experiences attenuate the association between neighbourhood violent crime and youth violence?

Results presented next are examinations of whether PCEs moderate the association between the level of violent crime in the neighbourhood and engagement in youth violence.

The method used is to examine neighbourhood violent crime as quintiles (lowest 20%, lowest 20–40%, middle 40–60%, highest 60–80% and highest 80–100%), and PCEs are examined as a binary variable: low (zero to four) vs high (five or more). All models include the full set of control variables.

Assault perpetration

Figure 3.10.1 and Table 3.10.1 show the results for assault perpetration. The prevalence of assault perpetration varies very little and insignificantly between levels of neighbourhood violence for those with high as well as for those with low PCEs. The risk ratios, comparing those from the lowest 20% violent crime neighbourhoods to those with higher levels of neighbourhood violent crime, are largely identical across the low and high PCEs groups, and, statistically, there are no significant differences between groups, as indicated in the interaction model (last column in the table).

Figure 3.10.1: Prevalence of assault perpetration by neighbourhood violent crime by high and low positive childhood experiences (PCEs)
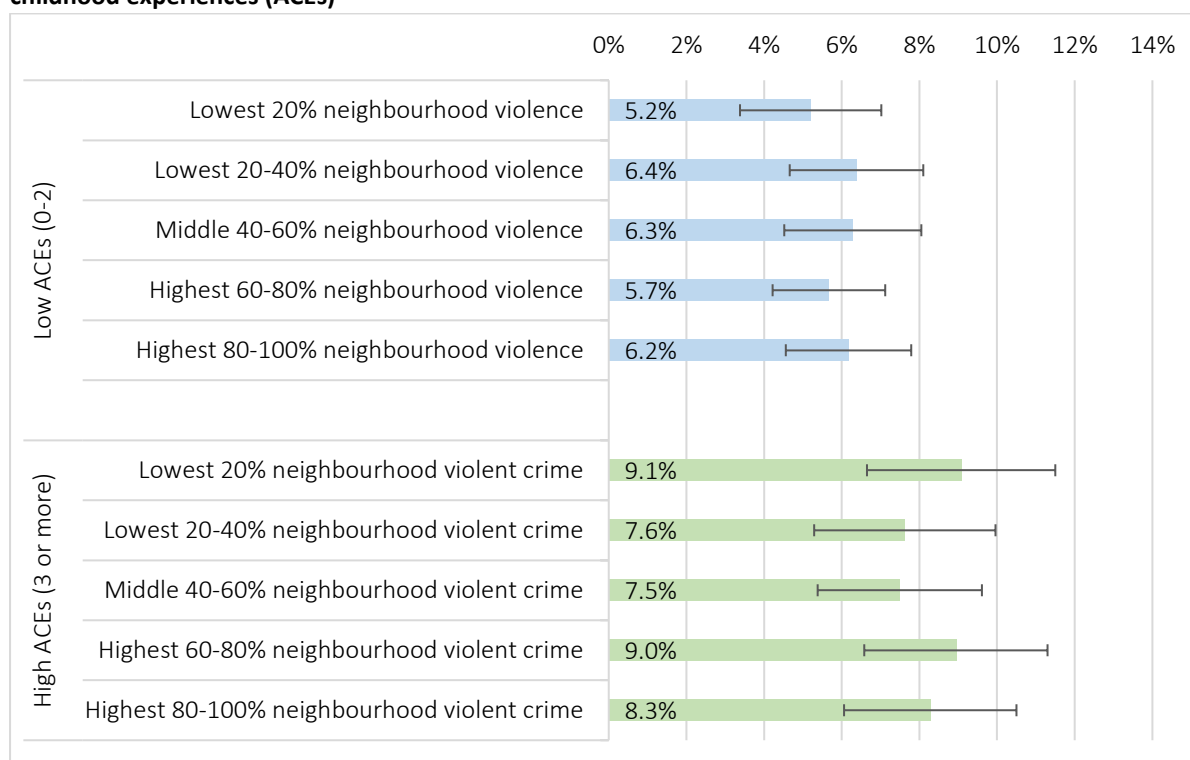

Notes: adjusted for sex at birth, ethnicity, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single and adverse childhood experiences. Capped lines indicate 95% confidence intervals.
Sample size N=14,088 (imputed sample). Results weighted for survey design.

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Table 3.10.1: Risk ratio (RR) differences in assault perpetration between neighbourhoods with low and higher levels of violent crime by low and high levels of positive childhood experiences (PCEs)

	Low PCEs (0–4)	High PCEs (5+)	Difference (high vs low PCEs)
	RR	RR	RR
Lowest 20% neighbourhood violent crime	Ref	Ref	Ref
Lowest 20–40% neighbourhood violent crime	1.04	1.06	1.02
Middle 40–60% neighbourhood violent crime	1.03	1.06	1.03
Highest 60–80% neighbourhood violent crime	1.07	1.04	0.97
Highest 80–100% neighbourhood violent crime	1.06	1.03	0.97

Notes: adjusted for sex at birth, ethnicity, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single and adverse childhood experiences. Differences between high and low PCEs were examined in an interaction model.
*** p<0.001, ** p<0.01, * p<0.05, + p<0.10.
Sample size N=14,088 (imputed sample). Results weighted for survey design.

Weapon involvement

Figure 3.10.2 and Table 3.10.2 report the results of the association between neighbourhood violent crime and weapon involvement for those with high and low PCEs. There is no statistical association in either group, which is consistent with the results for the overall sample reported for RQ5. The risk ratio differences between those with the lowest 20% neighbourhood violent crime compared to quintile groups with a higher level of neighbourhood violence are largely consistent between the low and high PCEs groups. The interaction results confirm that there is no significant difference between the high and low PCEs groups.

Figure 3.10.2: Prevalence of weapon involvement by neighbourhood violent crime by high and low positive childhood experiences (PCEs)
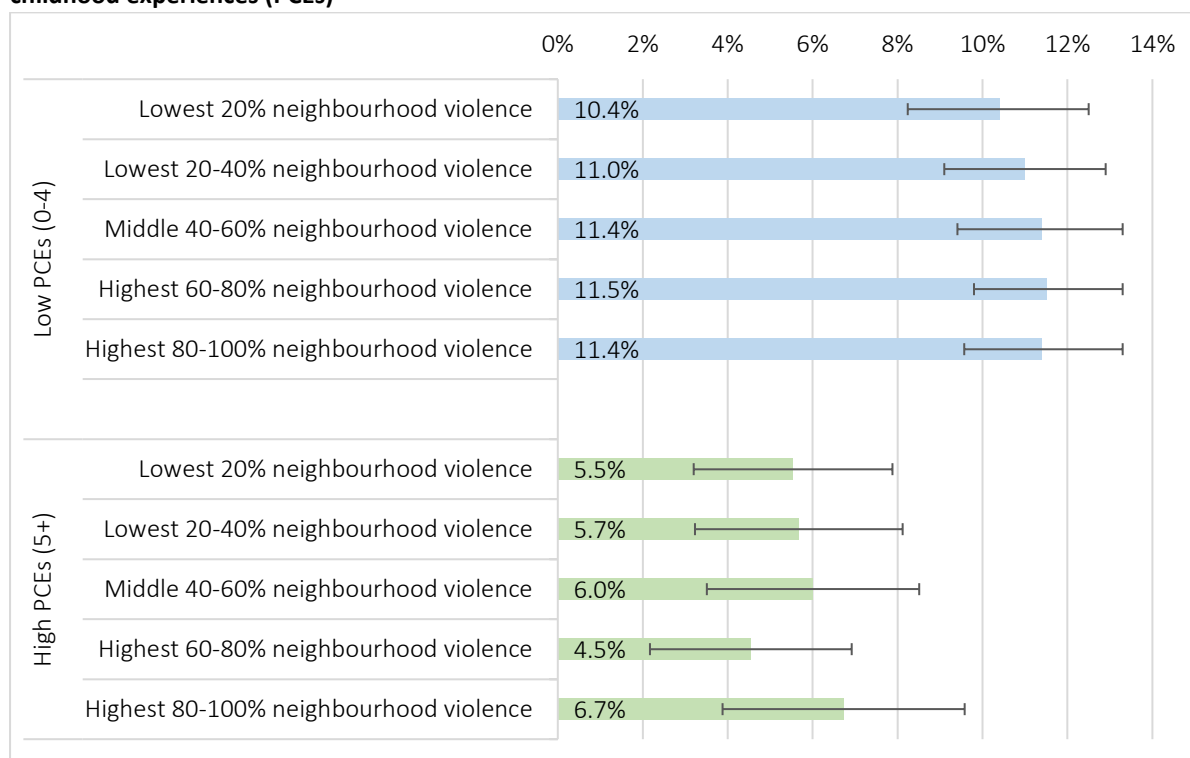
Notes: adjusted for sex at birth, ethnicity, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single and adverse childhood experiences. Capped lines indicate 95% confidence intervals.
Sample size N=14,088 (imputed sample). Results weighted for survey design.

Table 3.10.2: Risk ratio (RR) differences in weapon involvement between neighbourhoods with low and higher levels of violent crime by low and high levels of positive childhood experiences (PCEs)

	Low PCEs (0–4) RR	High PCEs (5+) RR	Difference (high vs low PCEs) RR
Lowest 20% neighbourhood violent crime	Ref	Ref	Ref
Lowest 20–40% neighbourhood violent crime	1.06	1.03	0.97
Middle 40–60% neighbourhood violent crime	1.10	1.08	0.98
Highest 60–80% neighbourhood violent crime	1.11	0.82	0.74
Highest 80–100% neighbourhood violent crime	1.10	1.21	1.10

Notes: adjusted for sex at birth, ethnicity, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single and adverse childhood experiences. Differences between high and low PCEs were examined in an interaction model.
*** $p<0.001$, ** $p<0.01$, * $p<0.05$, + $p<0.10$.
Sample size N=14,088 (imputed sample). Results weighted for survey design.

Gang involvement

Figure 3.10.3 and Table 3.10.3 report on the association between neighbourhood violent crime and gang involvement by high and low levels of PCEs. We see that the association between neighbourhood violent crime is not significant for either the high or the low PCEs group. However, it is noticeable that all risk ratios are greater than 1 for the low PCEs group, suggesting that a higher level of violence is associated with a higher risk of gang involvement, while for the high PCEs group, all risk ratios are below 1, which suggests a reverse association,

with higher violence being associated with a lower risk of gang involvement. However, as already noted, these associations are not statistically significant, nor are these differences between the ACEs groups significant from a statistical point of view, as indicated by the interaction model (last column in the table).

Figure 3.10.3: Prevalence of gang involvement by neighbourhood violent crime by high and low positive childhood experiences (PCEs)
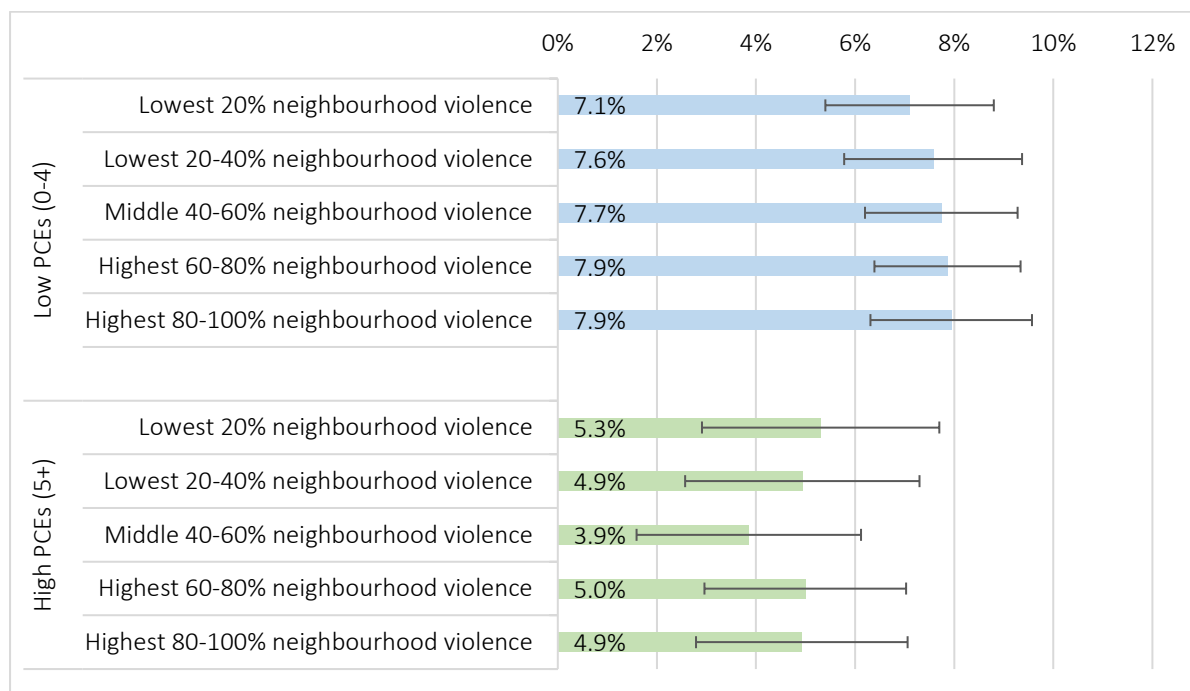
Notes: adjusted for sex at birth, ethnicity, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single and adverse childhood experiences. Capped lines indicate 95% confidence intervals. Sample size N=14,088 (imputed sample). Results weighted for survey design.

Table 3.10.3: Risk ratio (RR) differences in gang involvement between neighbourhoods with low and higher levels of violent crime by low and high levels of positive childhood experiences (PCEs)

	Low PCEs (0–4)	High PCEs (5+)	Difference (high vs low PCEs)
	RR	RR	RR
Lowest 20% neighbourhood violent crime	Ref	Ref	Ref
Lowest 20–40% neighbourhood violent crime	1.07	0.93	0.87
Middle 40–60% neighbourhood violent crime	1.09	0.73	0.67
Highest 60–80% neighbourhood violent crime	1.11	0.94	0.85
Highest 80–100% neighbourhood violent crime	1.12	0.93	0.83

Notes: adjusted for sex at birth, ethnicity, maternal age at birth, income, education, occupational status, the number of sweeps the parent was single and adverse childhood experiences. Differences between high and low PCEs weres examined in an interaction model.
*** p<0.001, ** p<0.01, * p<0.05, + p<0.10.
Sample size N=14,088 (imputed sample). Results weighted for survey design.

Summary of results for RQ10: do PCEs attenuate the association between neighbourhood violent crime and youth violence?

The results of the examinations show that the number of PCEs during childhood does not significantly attenuate the association between neighbourhood violent crime and youth violence. Therefore, our hypothesis that neighbourhood violent crime will have a weaker association with youth violence for those with a high level of PCEs because PCEs are a likely protective factor is not supported.

Conclusions and implications

Summary findings

The overall aim of this research project was to examine ACEs as well as PCEs and police-reported violent crimes in neighbourhoods and the interactions between these exposures in terms of their associations with youth violence outcomes (assault perpetration, weapon involvement and gang involvement) at ages 14 and 17. Differences in results between gender and ethnic groups were also examined. These analyses were carried out using a sample of 14,088 participants from the MCS in England and Wales.

Descriptive statistics showed that in terms of the youth violence outcomes at age 14 and 17 combined, 42.1% reported engagement in assault perpetration (pushing, shoving, hitting, slapping or punching someone), 9.7% had experienced weapon involvement (carrying or using a weapon) and 7.0% had gang involvement (current or past membership of a street gang).

Bivariate analyses showed that these youth violence outcomes, especially gang and weapon involvement, were highly socioeconomically patterned, as those from households with lower parental education, a lower occupational status and a lower income were much more at risk. There were also large socioeconomic differences in exposure to ACEs, PCEs and neighbourhood violent crime, with socioeconomically disadvantaged groups being much more likely to have a high number of ACEs, less likely to have a high number of PCEs and more likely to live in a neighbourhood with a high level of violent crime. The finding that ACEs are strongly related to poverty has previously been highlighted by Asmussen et al. (2020) in their comprehensive report on ACEs, highlighting that upstream structural inequalities must be addressed for ACE-related policies, services and interventions to have any meaningful effect. In addition, previous studies have indicated that PCEs are significantly linked to family income (Sege et al., 2024), as higher household income can provide better access to resources that foster positive experiences, such as quality education, extracurricular activities and safe neighbourhoods. There is also substantial evidence showing that poor people tend to live in neighbourhoods with high crime rates and that area crime and area deprivation are intrinsically linked (Lymperopoulou and Bannister, 2022, Trust for London, 2024).

Results of the multivariate regression models that controlled for a wide range of potential confounders, including socioeconomic factors, showed that those who had experienced six or more ACEs in early to late childhood, compared to no ACEs (RQ1), had a substantially higher risk of engaging in youth violence in adolescence. The association was especially strong for the two most serious types of crime – weapon (increased by 150%) and gang involvement (increased by 152%) – and less pronounced for assault perpetration (increased by 45%). The opposite pattern was seen for PCEs (RQ2), with those who had experienced six to seven PCEs

having a much-reduced risk of youth violence compared to those with zero to two PCEs, especially for weapon (reduced by 66%) and gang involvement (reduced by 59%) and less so for assault perpetration (reduced by 35%).

A high number of PCEs compared to a low number was also found to attenuate the detrimental association between high ACEs and youth violence (RQ3), with this attenuation being larger for weapon involvement (reduced by 49%) and gang involvement (reduced by 39%) than for assault perpetration (reduced by 22%). The association of youth violence outcomes with ACEs (RQ6) and PCEs (RQ7) and the moderation of the association between ACEs and youth violence by PCEs (RQ8) did not differ across neighbourhoods with varying levels of neighbourhood violent crime. The detrimental associations of ACEs and the protective associations of PCEs have been shown in many previous studies, both in relation to youth crime (Astridge et al., 2023, Baglivio and Epps, 2016, Baglivio and Wolff, 2021, Bellis et al., 2014, Duke et al., 2010, Fagan and Novak, 2018, Fox et al., 2015) and for other outcomes in adolescence as well as in adulthood (Appleton et al., 2017, Asmussen et al., 2020, Felitti et al., 1998, Houtepen et al., 2019, Huang et al., 2023, Ports et al., 2016, Straatmann et al., 2018). The buffering association of a high number of PCEs in the face of a high number of ACEs has also been found in existent studies on youth offending (Bethell et al., 2019, Baglivio and Wolff, 2021, Craig et al., 2017, Qu et al., 2022, Kowalski et al., 2023, Novak and Fagan, 2022).

This study found that police-recorded violent crime in the neighbourhood was associated with a higher risk of all youth violence outcomes when no other covariates were considered; however, when adjusting for a range of individual and family characteristics, including ACEs and PCEs, the associations became small and non-significant (RQ5). This indicates that the apparent effect of the neighbourhood on youth violence is explained largely by the characteristics of individuals and families living there rather than the characteristics of the neighbourhood itself. The association between neighbourhood violent crime and youth violence did not differ depending on the number of ACEs (RQ9) or PCEs (RQ10) that young people had been exposed to during childhood. The finding of no association between neighbourhood violent crime and youth violence in the current study is somewhat inconsistent with results from previous UK studies showing that neighbourhood crime rates are associated with individual offending, even when controlling for individual and family factors (Bottoms and Wiles, 2002, Farrington and West, 1993, Hirschfield and Bowers, 1997, MacDonald and Tinsley, 2019, Wikström et al., 2012). However, there are also several examples of UK studies that have shown that once relevant control variables are considered, the neighbourhood effect significantly diminishes or becomes non-significant (Bottoms and Wiles, 1986, Gibbons, 2004, Hope, 1995, Sampson et al., 2002, Smith, 2006, Tilley et al., 1999), which is more consistent with the results of the current study. Explanations for why different studies generate such different results may lie in the different methodological approaches used, such as the neighbourhood crime measures (see the Limitations section for further discussion), the offending outcomes being examined and how exposures and outcomes are measured. The number and types of control variables used are also likely factors. In our study,

we used a rich set of demographic and socioeconomic variables and included ACEs and PCEs in order to provide estimates that were as robust as possible to the well-known selection biases that complicate the study of neighbourhood effects.

The findings of this study supported our pre-specified hypothesis with regard to the ACEs, PCEs and their interactive association with youth violence (RQ1–RQ3). Our hypotheses were not supported in relation to neighbourhood violence, which had no significant bearing on youth violence outcomes (RQ5). Again, we refer to the Limitation section below for further discussion. As other hypotheses assumed neighbourhood violence to be a risk factor, these were not supported by the results of this study (RQ6–RQ10).

Gender differences

Males were found to be more at risk of youth violence than females, with the largest difference being for weapon involvement, followed by assault perpetration and then gang involvement. This gender pattern is well established in the criminological literature (DeLisi and Vaughn, 2016), and it is also reflected in official statistics, with the latest figures from 2023 showing that there were 251,311 arrests of men for violent crimes compared to 56,868 arrests of women (Home Office, 2024). Our results also showed that males experience more ACEs (driven by verbal and physical abuse) and fewer PCEs (driven by school connectedness, teacher-child relationships, low-risk peers and engagement in activities and hobbies). Previous studies have tended to show that girls have an increased risk of experiencing ACEs (Baglivio et al., 2014, Baglivio et al., 2015, Felitti et al., 1998), which appears to be driven by sexual abuse being more common among girls (Baglivio et al., 2014, Dierkhising et al., 2019). Because sexual abuse information was not available in the MCS, our study was not able to include this in our ACE framework. On the other hand, extant studies have indicated that boys are more likely to experience physical abuse (Baglivio et al., 2014, Dierkhising et al., 2013, Felitti et al., 1998), which is consistent with our study findings. Only a few previous studies that we have been able to identify have reported gender differences in exposure to PCEs. These include Huang et al. (2023) and Kowalski et al. (2023), which both showed a higher prevalence in females of low PCEs but no differences in having high PCEs, while another study found higher levels of PCEs in females (Arslan and Özyürek, 2023). However, the PCE items in these studies differed somewhat from our study by including positive family factors, whereas our focus was on positive experiences external to the family.

In terms of the youth violence outcomes studies and their associations with ACEs, PCEs and neighbourhood violence, the only substantial gender difference was for assault perpetration but not for the more serious outcomes: weapon involvement and gang involvement. ACEs increased the risk of assault perpetration more in females, PCEs had a larger reductive effect in females and neighbourhood violent crime increased the risk of assault perpetration also in females more than in males. These findings suggest that females may be more susceptible to

these exposures, at least in relation to assault perpetration. Previous studies have shown mixed results, with some indicating that males are more negatively affected by ACEs in terms of offending and related behaviours (Leban, 2021, Leban and Gibson, 2020), while others have shown that girls are more affected (Pierce and Jones, 2022). There is very little previous evidence in relation to gender differences in the effects of PCEs, as we found no study that had examined violence or related outcomes. Studies from the field of psychiatry have shown mixed results, with a stronger protective association of PCEs for females found in some studies (Craig et al., 2017, Skodol et al., 2007). However, Gunay-Oge et al. (2020) found no gender difference. In terms of gender differences in neighbourhood effects, some have proposed that girls might be less affected by neighbourhood context because, traditionally, girls may have less independence and spend less time in the neighbourhood than boys (Leote de Carvalho et al., 2023). However, some studies that have examined this have shown no discernible difference (Airaksinen et al., 2021, Jacob, 2006, Karriker-Jaffe et al., 2009, Molnar et al., 2008), while others are in support of boys being more vulnerable to neighbourhood effects (Kling et al., 2005, Kroneman et al., 2004).

Ethnic differences

In terms of ethnicity, those of Black ethnic background reported higher rates of assault perpetration compared to those of Asian and White ethnicities, but not different to those of Mixed ethnicity. Our findings are consistent with recent official statistics from England and Wales, showing that being of Black and Mixed ethnicities is associated with increased odds of receiving a custodial sentence for violence against the person offences and sexual offences, controlling for various offender and case characteristics (Ministry of Justice, 2024).

Those of Black ethnicity were also much more likely to live in neighbourhoods with the highest level of violent crime, especially compared to White participants, where the difference was stark, but also compared to all other ethnic groups examined (Asian, Mixed and Other ethnic groups). Our findings are consistent with official statistics showing the overrepresentation of ethnic minorities in areas with high levels of crime (Office for National Statistics, 2020).

ACEs increased the risk of assault perpetration in those of White ethnicity more than in those of Black ethnic background. This increased risk for White participants was also seen for weapon and gang involvement, although these differences were not statistically significant from other ethnic groups. There was no clear or significant ethnic pattern or difference in the association between PCEs and youth violence or in the association between neighbourhood violent crime and youth violence. Only a few previous studies have examined ethnicity as a moderator of these associations. Some are consistent with our current findings, such as Schilling et al. (2007), who found that ACEs were stronger predictors of delinquency in White youths than in Black youths, and Hunt et al. (2017) showed that ACEs were more predictive of externalising problems among White groups than Black groups. Other studies provide

evidence contrary to our findings, such as Fagan and Novak (2018), who found a detrimental association between ACEs and a range of delinquency outcomes in Black groups but not in White groups, and Jones et al. (2022), who showed a higher vulnerability to ACEs in ethnic minority groups.

While some studies have indicated that ethnic minority groups are less likely to experience PCEs than White groups (Crouch et al., 2021a), few have explicitly examined ethnic differences in the associations between PCEs and youth violence. A study that looked at PCEs and school readiness found similar results across ethnic groups (So et al., 2023), consistent with our findings. While we found no ethnic differences in neighbourhood effects, others have found that native people are more sensitive to neighbourhood poverty than immigrant groups in terms of adolescent problem behaviours (Oberwittler, 2013). Although, it should be noted that an ethnic minority background and an immigrant background are not the same thing.

This study provided some evidence that differences in experiences of violence by ethnicity can be explained by exposure to ACEs and PCEs. Children of Black ethnicity had a higher rate of assault perpetration (53.3%) than White children (41.7%). These differences in assault rates disappeared after controlling for family socioeconomic characteristics and ACEs and PCEs, suggesting much of the difference can be explained by differences in exposure to these family factors. However, this analysis was limited by a small sample size of children from individual ethnic minority groups and is, therefore, not as secure as some of the other findings.

Contribution of study

One of the main contributions of the current study is the provision of evidence on the correlates of youth violence outcomes, drawing on a wide range of risk and protective factors across the social ecology of children, including how these factors interact. The majority of previous studies on ACEs, PCEs and neighbourhood characteristics are based on US data. The current study is, therefore, one of the few to present comprehensive evidence from a UK context, which makes it more relevant and applicable in terms of informing policy and practice.

Implications

These findings should be interpreted carefully. Although the study looked at whether factors are associated with violence, it cannot confirm whether these factors caused violence. For example, children who experienced physical abuse were more likely to commit violence, but we can't rule out the possibility that this relationship is explained by another factor. Perhaps children who experienced abuse are also more likely to experience other hardships, which are the real drivers behind their involvement in violence. While this study used statistical

techniques to try to rule out some other potential drivers, it was not able to capture all of these.

The findings from this study have important implications for tackling youth violence. Insights from this study should be combined with findings from other research to identify and support the children who are most vulnerable to involvement in violence. They suggest that violence prevention efforts should work with children who've experienced ACEs, including parental drug use, domestic violence, physical abuse, a single parent and parents with a long-term illness or disability. Future research and work should also explore how protecting children from exposure to ACEs and promoting their exposure to PCEs could have a causal impact on reducing children's involvement in violence.

Because ACEs and PCEs have been shown to affect not only crime but also multiple other outcomes in adolescence and into adulthood, benefits to individuals from targeting these through interventions could be far-reaching. It would give children a better start in life and pave the way for better overall life chances. The potential societal benefits of this should also be highlighted, including lower public costs in terms of criminal justice, healthcare, social services and benefit payments (Heeks et al., 2018).

Although the current study focused exclusively on youth violence, it is important to emphasise that this has a strong correlation with other types of youth crimes. In previous analyses carried out on the MCS sample, we showed that those who had carried or used a weapon were much more likely to also be involved in a wide range of other offences, including shoplifting, neighbourhood crime, criminal damage and arson, and cybercrime (Villadsen and Fitzsimons, 2021). So, steps taken to prevent youth violence could also have a reductive effect on youth offending more widely and vice versa, i.e. reducing youth offending more generally would likely reduce youth violence. It is possible that ACEs and PCEs would also be associated with other youth offending behaviours; however, these examinations are outside the scope of this study and would be an important focus for future study.

Caveats and limitations

Although the MCS data are extremely rich and detailed, there are nevertheless some aspects included in the original ACE framework that are not measured in this cohort study: 1) sexual abuse and 2) household criminality (prison sentence). As in previous studies that have examined ACEs using the MCS (Jackson et al., 2022, Nweze et al., 2023, Straatmann et al., 2018), we were not able to include these dimensions in our ACE measure and acknowledge this as a study limitation. Both of these omitted ACEs are likely to be highly related to our youth violence outcomes. The estimates of the associations between ACEs and youth violence obtained in the current study might, therefore, be considered conservative compared to other studies that include these ACEs.

Other limitations pertain to the measures available in the data. Assault perpetration includes a very broad range of behaviours, from pushing to punching someone and, therefore, includes relatively minor offences as well as more serious ones. However, it is still a useful measure to examine alongside weapon involvement and gang involvement, as results can inform us of whether ACEs and PCEs have similar associations with serious offences as with less serious ones. Another measurement issue is that some ACEs and PCEs have been measured more frequently across childhood than others, and, therefore, their prevalence tends to be higher; this may also influence their associations with youth violence. A further limitation is that ACEs are prone to bias due to underreporting, which means that our estimates are likely to be conservative.

Both ACEs and PCEs could be driven by individual characteristics, meaning that the demeanour and behaviours of the child could influence responses from their environment. For example, a well-behaved child would be more likely to get on with their parent, teacher and peers; have a good school connectedness; and have low-risk peers. In additional analyses, we included child conduct problems at age 3 as an additional covariate to help mitigate this. The results showed that both ACEs and PCEs still had strong and significant associations with youth violence, with only minor reductions. However, there may be other important personal characteristics of children that are not accounted for. If this is the case, then we may have overestimated the strength of the associations of PCEs and ACEs with youth violence.

A further limitation is the use of police.uk data for the measurement of violent crime in the neighbourhood. Crime reported to the police does not accurately reflect the true volume of crime taking place, and it has been long recognised in the field of criminology that much crime goes unreported (Skogan, 1977). A problem in relation to crime at the neighbourhood or area level is that underreporting is related to social conditions that are unequally distributed across areas, with more underreporting in urban areas, socioeconomically deprived areas and areas with a high concentration of immigrant and ethnic minority groups (Buil-Gil et al., 2021). This may have biased our results and underestimated the association between neighbourhood violent crime and youth violence, which we found not to be statistically significant in our study.

A very important limitation is that the study design is inherently observational and not a controlled experiment, so we cannot estimate causal relationships. However, we have attempted to greatly reduce the extent of omitted variable bias by controlling for an extensive set of variables in the regression analysis, owing to the richness of MCS data collected over time. There could, of course, be other unmeasured confounding factors that we have not been able to account for. This includes genetic factors, as it is possible that the genetic predispositions of parents drive family dysfunction, and these are also passed on to their children, contributing to their violent behaviours. Future research should include polygenic scores as additional potential confounders.

It is also important to highlight the issue around the lack of statistical power to detect significant effects. Despite the large analytical sample, some analyses are likely to suffer from a reduction in statistical power due to the relatively low prevalence of weapon and gang involvement when these are examined by further subgroups. This issue is amplified if subgroups are also small in size, such as some ethnic minority groups. Because of this issue, we may have missed some subgroup effects. A related issue is the lack of model conversion in the ethnic difference examinations, which meant dropping the very small number of participants (N=107) who were of in the Other ethnic background group.

Despite these limitations, the study has the strength of using a large nationally representative sample of adolescents in England and Wales. The use of multiple imputations to deal with missingness and weighting for the survey sampling design means that estimates obtained in the study are as close as possible to that of the population of adolescents in England and Wales born close to the millennium.

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Appendix to methods

Table A2.0.1: ACEs considered for inclusion

	Reporter	Age 9 months	Age 3 years	Age 5 years	Age 7 years	Age 11 years
Single parent status	Main parent	x	x	x	x	x
Parental breakup	Main parent		x	x	x	x
Domestic violence	Main parent	x	x	x	x	x
	Partner	x	x	x	x	x
Verbal abuse	Interviewer		x			
	Main parent		x	x	x	
Physical abuse	Interviewer		x			
	Main parent		x	x	x	
Parental alcohol abuse	Main parent	x	x			x
	Partner	x	x			x
Parental drugs use	Main parent		x	x		
	Partner		x	x		
Poor parental mental health	Main parent	x	x	x	x	x
	Partner		x	x	x	x
Poor parental relationship	Main parent (unhappiness measure)	x	x	x	x	x
	Partner (unhappiness measure)	x	x	x	x	x
	Main parent (marital state measure)	x	x	x		
	Partner (marital state measure)	x	x	x		
Poor parent-child relationship	Main parent		x			
	Partner		x			
Lack of attachment in infancy	Main parent	x				
Parental longstanding illness or disability	Main parent	x		x	x	x
	Partner	x		x	x	x
Young carer	Participant					x

Table A2.0.2: Bivariate examination of single ACEs in relation to youth violence outcomes

	Reporter	Assault perpetration RR unadjusted	95% CI	Weapon involvement RR unadjusted	95% CI	Gang involvement RR unadjusted	95% CI
Single parent status	Main parent	1.18***	1.12 - 1.24	1.87***	1.60 - 2.18	2.46***	1.98 - 3.07
Parental breakup	Main parent	1.13***	1.07 - 1.20	1.58***	1.35 - 1.85	1.85***	1.53 - 2.24
Domestic violence	Either parent	1.13***	1.07 - 1.19	1.33***	1.13 - 1.56	1.28**	1.07 - 1.53
	Main parent	1.14***	1.07 - 1.22	1.48***	1.23 - 1.78	1.41**	1.12 - 1.78
	Partner	1.11***	1.05 - 1.19	1.28**	1.08 - 1.51	1.21+	0.98 - 1.48
Verbal abuse	Main parent and interviewer	1.21***	1.13 - 1.30	1.51***	1.25 - 1.84	1.74***	1.35 - 2.25
	Main Parent	1.18***	1.11 - 1.25	1.19	0.95 - 1.48	1.56***	1.21 - 2.01
Physical abuse	Main parent and interviewer	1.19**	1.07 - 1.32	1.61***	1.23 - 2.10	1.64**	1.15 - 2.35
	Main parent	1.21***	1.11 - 1.32	1.37**	1.09 - 1.72	1.26	0.93 - 1.71
Parental alcohol abuse	Either parent	1.12***	1.05 - 1.19	1.31**	1.09 - 1.56	1.13	0.91 - 1.40
	Main parent	1.10*	1.01 - 1.21	1.56***	1.20 - 2.01	1.32	0.94 - 1.84
	Partner	1.12**	1.04 - 1.20	1.19+	0.97 - 1.45	1.04	0.81 - 1.34
Parental drug use	Either parent	1.21***	1.13 - 1.30	1.76***	1.47 - 2.11	1.84***	1.49 - 2.26
	Main parent	1.33***	1.22 - 1.46	2.29***	1.87 - 2.81	2.18***	1.66 - 2.87
	Partner	1.18***	1.09 - 1.27	1.51***	1.19 - 1.90	1.63***	1.28 - 2.07
Poor parental mental health	Either parent	1.09**	1.02 - 1.16	1.55***	1.27 - 1.89	1.59***	1.27 - 2.00
	Main parent	1.11**	1.04 - 1.18	1.59***	1.30 - 1.94	1.66***	1.33 - 2.06
	Partner	1.03	0.91 - 1.15	1.46*	1.09 - 1.96	1.30	0.84 - 2.00
Poor parental relationship	Both parents (marital state measure)	1.11**	1.04 - 1.18	1.22*	1.02 - 1.47	1.07	0.84 - 1.36
	Both parents (unhappy item)	1.04	0.97 - 1.11	1.09	0.91 - 1.30	0.96	0.76 - 1.21
Poor parent-child relationship	Either parent	1.09*	1.02 - 1.17	1.36**	1.11 - 1.65	1.64***	1.31 - 2.04
	Main parent	1.14**	1.05 - 1.24	1.50***	1.18 - 1.91	1.91***	1.49 - 2.46
	Partner	1.04	0.95 - 1.14	1.19	0.94 - 1.52	1.24	0.90 - 1.71
Parental longstanding illness or disability	Either parent	1.11**	1.04 - 1.18	1.43***	1.21 - 1.70	1.24+	1.00 - 1.53
	Main parent	1.15***	1.07 - 1.24	1.62***	1.35 - 1.95	1.54***	1.24 - 1.91
	Partner	1.04	0.95 - 1.14	1.07	0.79 - 1.45	0.80	0.55 - 1.16
Young carer	Participant	1.02	0.95 - 1.09	1.17	0.96 - 1.41	1.08	0.87 - 1.35

Notes: Each single ACE is examined in individual models. Lack of attachment in infancy was also tested (prior to imputation) but dropped due to lack of association with youth violence outcomes. Highlighted in grey are measures making up the final ACEs measure used in the study.
*** p<0.001, ** p<0.01, * p<0.05, + p<0.10

Table A2.0.3: PCEs considered for inclusion

	Reporter	Age 9 months	Age 3 years	Age 5 years	Age 7 years	Age 11 years
In formal childcare	Main parent		x			
Good school connectedness	Participant				x	x
Positive teacher-child relationship	Participant					x
Feeling safe in school playground	Participant				x	
Low-risk peers	Participant					x
Positive peer experiences	Participant				x	x
Participation in activities and hobbies	Participant					x
Living in a safe neighbourhood	Main parent	x	x			
	Participant					x

Table A2.0.4: Bivariate examination of single PCEs domains in relation to youth violence outcomes

	Assault perpetration RR unadjusted	95% CI	Weapon involvement RR unadjusted	95% CI	Gang involvement RR unadjusted	95% CI
Formal childcare	1.01	0.95 - 1.07	0.83+	0.68 - 1.01	0.79+	0.62 - 1.01
Good school connectedness	0.68***	0.63 - 0.73	0.41***	0.31 - 0.54	0.51***	0.40 - 0.65
Positive teacher-child relationship	0.79***	0.74 - 0.84	0.46***	0.38 - 0.55	0.56***	0.44 - 0.70
Feeling safe in playground	0.90***	0.85 - 0.95	0.72***	0.62 - 0.84	0.72***	0.60 - 0.87
Low-risk peers	0.72***	0.68 - 0.77	0.37***	0.31 - 0.44	0.36***	0.29 - 0.45
Positive peer experiences	0.81***	0.76 - 0.85	0.58***	0.48 - 0.69	0.58***	0.45 - 0.75
Participation in activities and hobbies	0.84***	0.79 - 0.89	0.61***	0.52 - 0.71	0.66***	0.54 - 0.81
Living in a safe neighbourhood	0.88***	0.84 - 0.93	0.64***	0.55 - 0.74	0.60***	0.52 - 0.70

Notes: Each single PCE is examined in individual models. Frequency of seeing grandparents, and attendance at afterschool club, were also tested (prior to imputation) but were dropped due to lack of association with youth violence outcomes. Highlighted in grey are domains making up the final PCEs measure. *** p<0.001, ** p<0.01, * p<0.05, + p<0.10

Table A2.0.5: Extent of missing data on each variables in the study and imputation model

Variable	Missing	Not missing	Sample	% missing
Child sex	0	18,282	18,282	0%
Country	0	18,282	18,282	0%
Ethnicity	0	18,282	18,282	0%
Public nuisance ever (age 11)	6,054	12,228	18,282	33%
Graffiti ever (age 11)	6,020	12,262	18,282	33%
Vandalism ever (age11)	6,091	12,191	18,282	33%
Shoplifting ever (age 11)	6,031	12,251	18,282	33%
Public nuisance last 12 months (age 14)	7,622	10,660	18,282	42%
Graffiti last 12 months (age 14)	7,614	10,668	18,282	42%
Vandalism last 12 months (age 14)	7,620	10,662	18,282	42%
Shoplifting last 12 months (age 14)	7,622	10,660	18,282	42%
Theft from person last 12 months (age 14)	7,620	10,662	18,282	42%
Assault last 12 months (age 14)	7,621	10,661	18,282	42%
Gang involvement ever (age 14)	7,622	10,660	18,282	42%
Graffiti last 12 months (age 17)	8,766	9,516	18,282	48%
Vandalism last 12 months (age 17)	8,791	9,491	18,282	48%
Shoplifting last 12 months (age 17)	8,762	9,520	18,282	48%
Assault last 12 months (age 17)	8,761	9,521	18,282	48%
Gang involvement ever (age 17)	11,847	6,435	18,282	65%
Weapon involvement ever (age 14)	7,629	10,653	18,282	42%
Weapon involvement last 12 months (age 17)	11,920	6,362	18,282	65%
Parental happiness (main parent reported) age 9 months	4,072	14,210	18,282	22%
Domestic violence against main parent (age 9 months)	883	17,399	18,282	5%
Parental happiness (partner reported) age 9 months	6,035	12,247	18,282	33%
Domestic violence against partner (age 9 months)	2,849	15,433	18,282	16%
Parental happiness (main parent reported) age 3 years	7,458	10,824	18,282	41%
Domestic violence against main parent (age 3 years)	4,919	13,363	18,282	27%
Parental happiness (partner reported) age 3 years	8,847	9,435	18,282	48%
Domestic violence against partner (age 3 years)	6,256	12,026	18,282	34%
Parental happiness (main parent reported) age 5 years	7,370	10,912	18,282	40%
Domestic violence against main parent (age 5 years)	4,416	13,866	18,282	24%
Parental happiness (partner reported) age 5 years	8,798	9,484	18,282	48%
Domestic violence against partner (age 5 years)	5,900	12,382	18,282	32%
Parental happiness (main parent reported) age 7 years	8,407	9,875	18,282	46%
Domestic violence against main parent (age 7 years)	5,574	12,708	18,282	30%
Parental happiness (partner reported) age 7 years	9,885	8,397	18,282	54%
Domestic violence against partner (age 7 years)	7,094	11,188	18,282	39%
Parental happiness (main parent reported) age 11 years	9,269	9,013	18,282	51%
Domestic violence against main parent (age 11 years)	6,217	12,065	18,282	34%
Parental relationship (partner reported) age 11 years	10,378	7,904	18,282	57%
Domestic violence against partner (age 11 years)	7,370	10,912	18,282	40%
Mental health distress main parent (age 3 years)	5,200	13,082	18,282	28%

Mental health distress partner (age 3 years)	8,756	9,526	18,282	48%
Mother child relationship (age 3 years)	5,340	12,942	18,282	29%
Father child relationship (age 3 years)	8,799	9,483	18,282	48%
Mental health distress main parent (age 5 years)	4,633	13,649	18,282	25%
Mental health distress partner (age 5 years)	8,737	9,545	18,282	48%
Mental health distress main parent (age 7 years)	5,731	12,551	18,282	31%
Mental health distress partner (age 7 years)	9,840	8,442	18,282	54%
Parental breakup between age 9 month and age 3	3,666	14,616	18,282	20%
Parental breakup between age 3 and 5	5,289	12,993	18,282	29%
Parental breakup between age 5 and 7	5,699	12,583	18,282	31%
Parental breakup between age 7 and 11	6,802	11,480	18,282	37%
Household education (age 9 months)	464	17,818	18,282	3%
Household occupational status (age 9 months)	831	17,451	18,282	5%
Household income (age 9 months)	195	18,087	18,282	1%
Household income (age 3 years)	3,819	14,463	18,282	21%
Household income (age 5 years)	3,949	14,333	18,282	22%
Household income (age 7 years)	5,276	13,006	18,282	29%
Household income (age 11 years)	5,643	12,639	18,282	31%
Household income (age 14 years)	7,137	11,145	18,282	39%
Maternal age at birth	21	18,261	18,282	0%
Conduct problems SDQ (age 3)	4,292	13,990	18,282	23%
Conduct problems SDQ (age 5)	4,258	14,024	18,282	23%
Conduct problems SDQ (age 7)	5,452	12,830	18,282	30%
Conduct problems SDQ (age 11)	6,090	12,192	18,282	33%
Conduct problems SDQ (age 14)	7,562	10,720	18,282	41%
Conduct problems SDQ (age 17)	9,424	8,858	18,282	52%
Single parent household (age 9 months)	0	18,282	18,282	0%
Single parent household (age 3 years)	3,666	14,616	18,282	20%
Single parent household (age 5 years)	3,806	14,476	18,282	21%
Single parent household (age 7 years)	5,091	13,191	18,282	28%
Single parent household (age 11 years)	5,643	12,639	18,282	31%
Physical abuse main reported (age 3)	5,388	12,894	18,282	29%
Physical abuse main reported (age 5)	4,705	13,577	18,282	26%
Physical abuse main reported (age 7)	5,789	12,493	18,282	32%
Verbal abuse main reported (age 3)	5,450	12,832	18,282	30%
Verbal abuse main reported(age 5)	4,679	13,603	18,282	26%
Verbal abuse main reported (age 7)	5,742	12,540	18,282	31%
Verbal abuse interviewer reported (age 3)	4,760	13,522	18,282	26%
Physical abuse interviewer reported (age 3)	4,586	13,696	18,282	25%
Mother alcohol abuse (9 months)	37	18,245	18,282	0%
Partner alcohol abuse (9 months)	5,256	13,026	18,282	29%
Mother alcohol abuse (3 years)	4,251	14,031	18,282	23%
Partner alcohol abuse (3 years)	8,482	9,800	18,282	46%
Mother alcohol abuse (11 years)	6,566	11,716	18,282	36%
Partner alcohol abuse (11 years)	10,375	7,907	18,282	57%
Mother drug use (age 3 years)	5,339	12,943	18,282	29%
Partner drug use (age 3 years)	8,940	9,342	18,282	49%

Mother drug use (age 5 years)	4,836	13,446	18,282	26%
Partner drug use (age 5 years)	8,903	9,379	18,282	49%
Mental distress main parent (age 9 months)	622	17,660	18,282	3%
Mental health distress main parent (age 11 years)	6,709	11,573	18,282	37%
Mental health distress partner (age 11 years)	10,476	7,806	18,282	57%
Parental relationship (main parent reported) age 9 months	4,616	13,666	18,282	25%
Parental relationship (partner reported) age 9 months	6,579	11,703	18,282	36%
Parental relationship (main parent reported) age 3 years	7,715	10,567	18,282	42%
Parental relationship (partner reported) age 3 years	9,870	8,412	18,282	54%
Parental relationship (main parent reported) age 5 years	7,534	10,748	18,282	41%
Parental relationship (partner reported) age 5 years	9,071	9,211	18,282	50%
Mother child attachment (age 9 months)	3,192	15,090	18,282	17%
Main parent longstanding illness/disability (age 9 months)	22	18,260	18,282	0%
Partner longstanding illness/disability (age 9 months)	5,268	13,014	18,282	29%
Main parent longstanding illness/disability (age 5 years)	3,884	14,398	18,282	21%
Partner longstanding illness/disability (age 5 years)	8,268	10,014	18,282	45%
Main parent longstanding illness/disability (age 7 years)	5,176	13,106	18,282	28%
Partner longstanding illness/disability (age 7 years)	9,497	8,785	18,282	52%
Main parent longstanding illness/disability (age 11 years)	5,753	12,529	18,282	31%
Partner longstanding illness/disability (age 11 years)	9,838	8,444	18,282	54%
Young carer	5,747	12,535	18,282	31%
Childcare type age 3 years	3,613	14,669	18,282	20%
School connectedness (age 7 years)	6,300	11,982	18,282	34%
School connectedness (age 11 years)	6,274	12,008	18,282	34%
Teacher-child relationship (age 11 years)	6,447	11,835	18,282	35%
Feeling safe in playground	6,133	12,149	18,282	34%
Sports activities (age 7 years)	5,161	13,121	18,282	28%
Sports activities (age 11 years)	5,744	12,538	18,282	31%
Arts and crafts (age 7 years)	6,005	12,277	18,282	33%
Reading (age 7 years)	6,099	12,183	18,282	33%
Arts and crafts (age 11 years)	5,998	12,284	18,282	33%
Reading (age 11 years)	5,985	12,297	18,282	33%
Positive peer experiences (age 7)	6,054	12,228	18,282	33%
Positive peer experiences (age 11)	6,093	12,189	18,282	33%
Peer smoking (age 11)	7,205	11,077	18,282	39%
Peer drinking (age 11)	7,695	10,587	18,282	42%
Living in safe neighbourhood (age 3)	3,706	14,576	18,282	20%
Living in safe neighbourhood (age 5)	3,895	14,387	18,282	21%
Living in safe neighbourhood (age 11)	6,146	12,136	18,282	34%

Appendix to descriptives

Table A3.0.1: ACEs | by gender

	Prop	95% CI lower	95% CI upper
No ACEs | Female	20.3%	18.9%	21.7%
No ACEs | Male	18.7%	17.4%	20.0%
One ACE | Female	25.0%	23.4%	26.5%
One ACE | Male	22.6%	21.3%	24.0%
Two ACEs | Female	21.8%	20.5%	23.2%
Two ACEs | Male	21.8%	20.6%	23.0%
Three ACEs | Female	14.8%	13.7%	16.0%
Three ACEs | Male	16.0%	14.9%	17.1%
Four ACEs | Female	9.5%	8.5%	10.5%
Four ACEs | Male	10.5%	9.6%	11.4%
Five ACEs | Female	5.1%	4.4%	5.8%
Five ACEs | Male	5.6%	4.8%	6.4%
Six or more ACEs | Female	3.5%	2.9%	4.1%
Six or more ACEs | Male	4.7%	4.0%	5.5%

Table A3.0.2: ACEs | by ethnicity

	Prop	95% CI lower	95% CI upper
No ACEs | White	19.8%	18.6%	21.0%
No ACEs | Mixed	11.9%	8.3%	15.4%
No ACEs | Asian	21.3%	18.3%	24.4%
No ACEs | Black	13.7%	8.9%	18.5%
No ACEs | Other	18.5%	8.4%	28.6%
One ACE | White	23.8%	22.7%	24.9%
One ACE | Mixed	18.3%	13.8%	22.8%
One ACE | Asian	24.9%	21.6%	28.2%
One ACE | Black	24.7%	20.1%	29.2%
One ACE | Other	29.1%	15.1%	43.1%
Two ACEs | White	21.6%	20.6%	22.6%
Two ACEs | Mixed	24.2%	19.3%	29.1%
Two ACEs | Asian	22.0%	19.0%	25.0%
Two ACEs | Black	25.4%	19.8%	31.0%
Two ACEs | Other	25.9%	12.4%	39.3%
Three ACEs | White	15.3%	14.4%	16.2%
Three ACEs | Mixed	18.3%	13.6%	22.9%
Three ACEs | Asian	14.8%	12.3%	17.4%
Three ACEs | Black	18.9%	14.7%	23.0%
Three ACEs | Other	13.9%	4.2%	23.5%
Four ACEs | White	9.9%	9.1%	10.7%
Four ACEs | Mixed	13.9%	9.9%	17.9%
Four ACEs | Asian	9.4%	7.3%	11.5%

	Prop	95% CI lower	95% CI upper
Four ACEs | Black	10.0%	6.8%	13.2%
Four ACEs | Other	5.8%	-0.8%	12.3%
Five ACEs | White	5.3%	4.7%	5.9%
Five ACEs | Mixed	7.8%	4.5%	11.1%
Five ACEs | Asian	4.8%	3.3%	6.2%
Five ACEs | Black	4.4%	2.1%	6.7%
Five ACEs | Other	3.9%	-0.8%	8.6%
Six or more ACEs | White	4.2%	3.7%	4.8%
Six or more ACEs | Mixed	5.7%	3.2%	8.2%
Six or more ACEs | Asian	2.7%	1.6%	3.9%
Six or more ACEs | Black	3.0%	1.4%	4.7%
Six or more ACEs | Other	3.0%	-1.2%	7.3%

Table A3.0.3: ACEs | by maternal age at birth

	Prop	95% CI lower	95% CI upper
No ACEs | Under 20	4.5%	3.0%	6.1%
No ACEs | 20 to 24	9.9%	8.4%	11.4%
No ACEs | 25 to 29	19.6%	18.0%	21.3%
No ACEs | 30 to 35	25.6%	23.9%	27.3%
No ACEs | 36 or over	24.9%	22.2%	27.7%
One ACE | Under 20	18.1%	15.2%	21.0%
One ACE | 20 to 24	19.8%	17.5%	22.1%
One ACE | 25 to 29	23.4%	21.6%	25.2%
One ACE | 30 to 35	26.2%	24.5%	28.0%
One ACE | 36 or over	26.9%	24.5%	29.3%
Two ACEs | Under 20	25.8%	22.4%	29.2%
Two ACEs | 20 to 24	23.5%	21.4%	25.7%
Two ACEs | 25 to 29	22.6%	20.9%	24.3%
Two ACEs | 30 to 35	20.2%	18.8%	21.6%
Two ACEs | 36 or over	19.7%	17.2%	22.1%
Three ACEs | Under 20	20.1%	17.3%	22.9%
Three ACEs | 20 to 24	19.6%	17.5%	21.6%
Three ACEs | 25 to 29	15.1%	13.6%	16.5%
Three ACEs | 30 to 35	13.4%	12.1%	14.7%
Three ACEs | 36 or over	13.3%	11.3%	15.3%
Four ACEs | Under 20	15.2%	12.4%	17.9%
Four ACEs | 20 to 24	13.5%	11.8%	15.2%
Four ACEs | 25 to 29	9.6%	8.4%	10.7%
Four ACEs | 30 to 35	8.2%	7.1%	9.2%
Four ACEs | 36 or over	8.0%	6.3%	9.7%
Five ACEs | Under 20	9.2%	7.0%	11.4%
Five ACEs | 20 to 24	7.1%	5.7%	8.6%
Five ACEs | 25 to 29	5.5%	4.5%	6.5%
Five ACEs | 30 to 35	3.8%	3.0%	4.5%
Five ACEs | 36 or over	4.5%	3.3%	5.8%
Six or more ACEs | Under 20	7.1%	5.5%	8.8%
Six or more ACEs | 20 to 24	6.5%	5.3%	7.8%

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	Prop	95% CI lower	95% CI upper
Six or more ACEs | 25 to 29	4.2%	3.5%	5.0%
Six or more ACEs | 30 to 35	2.7%	2.1%	3.3%
Six or more ACEs | 36 or over	2.7%	1.6%	3.8%

Table A3.0.4: ACEs | by household income

	Prop	95% CI lower	95% CI upper
No ACEs | Lowest 20% income	4.3%	3.1%	5.6%
No ACEs | Lowest 20-40% income	8.3%	6.9%	9.7%
No ACEs | Middle 40-60%	16.3%	14.5%	18.2%
No ACEs | Highest 60-80% income	25.9%	23.9%	27.8%
No ACEs | Highest 80-100% income	32.8%	30.6%	35.0%
One ACE | Lowest 20% income	16.8%	14.7%	18.8%
One ACE | Lowest 20-40% income	18.6%	16.6%	20.6%
One ACE | Middle 40-60%	22.4%	20.3%	24.4%
One ACE | Highest 60-80% income	26.3%	24.1%	28.4%
One ACE | Highest 80-100% income	30.2%	28.2%	32.2%
Two ACEs | Lowest 20% income	23.5%	21.2%	25.9%
Two ACEs | Lowest 20-40% income	22.9%	20.7%	25.1%
Two ACEs | Middle 40-60%	23.0%	20.7%	25.2%
Two ACEs | Highest 60-80% income	21.4%	19.3%	23.4%
Two ACEs | Highest 80-100% income	19.6%	17.8%	21.3%
Three ACEs | Lowest 20% income	20.0%	17.8%	22.3%
Three ACEs | Lowest 20-40% income	19.5%	17.4%	21.6%
Three ACEs | Middle 40-60%	17.2%	15.3%	19.1%
Three ACEs | Highest 60-80% income	13.5%	12.0%	15.1%
Three ACEs | Highest 80-100% income	10.2%	8.8%	11.6%
Four ACEs | Lowest 20% income	16.3%	14.3%	18.4%
Four ACEs | Lowest 20-40% income	14.3%	12.4%	16.2%
Four ACEs | Middle 40-60%	10.9%	9.3%	12.6%
Four ACEs | Highest 60-80% income	7.7%	6.5%	9.0%
Four ACEs | Highest 80-100% income	4.7%	3.7%	5.6%
Five ACEs | Lowest 20% income	9.5%	7.7%	11.3%
Five ACEs | Lowest 20-40% income	8.9%	7.5%	10.3%
Five ACEs | Middle 40-60%	6.0%	4.7%	7.4%
Five ACEs | Highest 60-80% income	3.3%	2.3%	4.3%
Five ACEs | Highest 80-100% income	1.8%	1.2%	2.4%
Six or more ACEs | Lowest 20% income	9.5%	7.9%	11.1%
Six or more ACEs | Lowest 20-40% income	7.4%	5.9%	8.9%
Six or more ACEs | Middle 40-60%	4.1%	3.1%	5.1%
Six or more ACEs | Highest 60-80% income	2.0%	1.3%	2.6%
Six or more ACEs | Highest 80-100% income	0.7%	0.4%	1.1%

Table A3.0.5: ACEs | by education

	Prop	95% CI lower	95% CI upper
No ACEs	No qualifications	5.7%	4.0%	7.4%
No ACEs	NVQ level 1	9.9%	7.6%	12.2%
No ACEs	NVQ level 2	16.1%	14.4%	17.8%
No ACEs	NVQ level 3	18.0%	15.9%	20.0%
No ACEs	NVQ level 4	24.5%	22.9%	26.2%
No ACEs	NVQ level 5	31.7%	28.4%	35.1%
One ACE	No qualifications	18.4%	15.3%	21.4%
One ACE	NVQ level 1	19.9%	16.7%	23.1%
One ACE	NVQ level 2	21.0%	19.2%	22.7%
One ACE	NVQ level 3	22.9%	20.9%	25.0%
One ACE	NVQ level 4	26.6%	25.0%	28.1%
One ACE	NVQ level 5	30.0%	26.1%	33.8%
Two ACEs	No qualifications	26.2%	22.9%	29.6%
Two ACEs	NVQ level 1	24.6%	20.9%	28.4%
Two ACEs	NVQ level 2	22.3%	20.4%	24.1%
Two ACEs	NVQ level 3	21.1%	18.9%	23.2%
Two ACEs	NVQ level 4	21.1%	19.7%	22.6%
Two ACEs	NVQ level 5	18.3%	15.2%	21.3%
Three ACEs	No qualifications	20.4%	17.5%	23.4%
Three ACEs	NVQ level 1	17.6%	14.4%	20.9%
Three ACEs	NVQ level 2	16.3%	14.6%	18.0%
Three ACEs	NVQ level 3	16.7%	14.6%	18.7%
Three ACEs	NVQ level 4	13.6%	12.3%	14.9%
Three ACEs	NVQ level 5	11.7%	9.2%	14.2%
Four ACEs	No qualifications	13.9%	11.2%	16.6%
Four ACEs	NVQ level 1	13.9%	10.9%	16.8%
Four ACEs	NVQ level 2	12.0%	10.5%	13.5%
Four ACEs	NVQ level 3	10.4%	8.9%	11.9%
Four ACEs	NVQ level 4	8.0%	6.9%	9.1%
Four ACEs	NVQ level 5	5.2%	3.6%	6.8%
Five ACEs	No qualifications	8.5%	6.4%	10.6%
Five ACEs	NVQ level 1	7.0%	4.8%	9.1%
Five ACEs	NVQ level 2	7.0%	5.8%	8.1%
Five ACEs	NVQ level 3	6.0%	4.7%	7.4%
Five ACEs	NVQ level 4	3.8%	3.1%	4.5%
Five ACEs	NVQ level 5	1.7%	0.7%	2.7%
Six or more ACEs	No qualifications	6.9%	5.2%	8.6%
Six or more ACEs	NVQ level 1	7.1%	5.1%	9.2%
Six or more ACEs	NVQ level 2	5.4%	4.4%	6.3%
Six or more ACEs	NVQ level 3	4.9%	3.7%	6.1%
Six or more ACEs	NVQ level 4	2.4%	1.9%	2.9%
Six or more ACEs	NVQ level 5	1.5%	0.6%	2.4%

Table A3.0.6: ACEs | by country

	Prop	95% CI lower	95% CI upper
No ACEs | England	20.0%	18.8%	21.2%
No ACEs | Wales	17.6%	15.3%	20.0%
One ACE | England	23.7%	22.5%	24.8%
One ACE | Wales	24.1%	21.9%	26.3%
Two ACEs | England	22.0%	20.9%	23.1%
Two ACEs | Wales	21.0%	19.1%	23.0%
Three ACEs | England	15.0%	14.1%	15.9%
Three ACEs | Wales	16.9%	15.0%	18.9%
Four ACEs | England	9.9%	9.1%	10.6%
Four ACEs | Wales	10.6%	9.0%	12.1%
Five ACEs | England	5.4%	4.8%	6.0%
Five ACEs | Wales	5.2%	4.1%	6.4%
Six or more ACEs | England	4.1%	3.5%	4.6%
Six or more ACEs | Wales	4.5%	3.5%	5.5%

Table A3.0.7: PCEs | by gender

	Prop	95% CI lower	95% CI upper
0-2 PCEs | Female	14.6%	13.3%	15.9%
0-2 PCEs | Male	23.1%	21.7%	24.6%
3 PCEs | Female	22.1%	20.6%	23.6%
3 PCEs | Male	25.3%	24.1%	26.5%
4 PCEs | Female	26.3%	24.9%	27.8%
4 PCEs | Male	25.4%	23.9%	26.8%
5 PCEs | Female	20.3%	19.0%	21.5%
5 PCEs | Male	16.9%	15.8%	18.1%
6-7 PCEs | Female	16.7%	14.7%	18.7%
6-7 PCEs | Male	9.3%	8.1%	10.5%

Table A3.0.8: PCEs | by ethnicity

	Prop	95% CI lower	95% CI upper
0-2 PCEs | White	18.9%	17.7%	20.1%
0-2 PCEs | Mixed	22.3%	17.8%	26.9%
0-2 PCEs | Asian	17.6%	14.8%	20.3%
0-2 PCEs | Black	22.4%	17.6%	27.3%
0-2 PCEs | Other	16.0%	5.4%	26.5%
3 PCEs | White	23.5%	22.4%	24.6%
3 PCEs | Mixed	22.7%	18.0%	27.5%
3 PCEs | Asian	25.2%	22.2%	28.2%
3 PCEs | Black	27.7%	22.7%	32.7%

	Prop	95% CI lower	95% CI upper
3 PCEs | Other	26.2%	14.4%	38.0%
4 PCEs | White	25.9%	24.7%	27.1%
4 PCEs | Mixed	26.3%	21.1%	31.4%
4 PCEs | Asian	25.1%	21.9%	28.2%
4 PCEs | Black	24.5%	19.8%	29.3%
4 PCEs | Other	23.1%	10.3%	35.9%
5 PCEs | White	18.8%	17.8%	19.7%
5 PCEs | Mixed	16.1%	11.5%	20.6%
5 PCEs | Asian	18.0%	15.4%	20.7%
5 PCEs | Black	15.0%	10.4%	19.6%
5 PCEs | Other	24.4%	13.8%	34.9%
6-7 PCEs | White	12.9%	11.4%	14.4%
6-7 PCEs | Mixed	12.6%	9.2%	16.1%
6-7 PCEs | Asian	14.1%	11.1%	17.1%
6-7 PCEs | Black	10.3%	6.6%	14.1%
6-7 PCEs | Other	10.3%	2.5%	18.2%

Table A3.0.9: PCEs | by maternal age at birth

	Prop	95% CI lower	95% CI upper
0-2 PCEs | Under 20	30.0%	26.6%	33.3%
0-2 PCEs | 20 to 24	24.7%	22.5%	26.8%
0-2 PCEs | 25 to 29	18.3%	16.6%	20.0%
0-2 PCEs | 30 to 35	15.6%	14.1%	17.0%
0-2 PCEs | 36 or over	15.3%	12.9%	17.7%
3 PCEs | Under 20	26.6%	23.4%	29.8%
3 PCEs | 20 to 24	26.2%	23.9%	28.5%
3 PCEs | 25 to 29	23.4%	21.6%	25.2%
3 PCEs | 30 to 35	21.8%	20.2%	23.4%
3 PCEs | 36 or over	24.6%	21.8%	27.3%
4 PCEs | Under 20	23.0%	19.9%	26.1%
4 PCEs | 20 to 24	24.8%	22.5%	27.1%
4 PCEs | 25 to 29	26.6%	24.7%	28.6%
4 PCEs | 30 to 35	26.5%	24.8%	28.3%
4 PCEs | 36 or over	25.4%	22.7%	28.0%
5 PCEs | Under 20	13.3%	10.5%	16.2%
5 PCEs | 20 to 24	15.4%	13.5%	17.3%
5 PCEs | 25 to 29	17.9%	16.3%	19.5%
5 PCEs | 30 to 35	20.8%	19.4%	22.3%
5 PCEs | 36 or over	21.4%	18.7%	24.0%
6-7 PCEs | Under 20	7.1%	5.3%	8.9%
6-7 PCEs | 20 to 24	9.0%	7.5%	10.5%
6-7 PCEs | 25 to 29	13.7%	11.8%	15.6%
6-7 PCEs | 30 to 35	15.2%	13.3%	17.2%
6-7 PCEs | 36 or over	13.4%	10.8%	16.0%

Table A3.0.10: PCEs | by household income

	Prop	95% CI lower	95% CI upper
0-2 PCEs | Lowest 20% income	32.6%	29.7%	35.4%
0-2 PCEs | Lowest 20-40% income	27.9%	25.5%	30.2%
0-2 PCEs | Middle 40-60%	19.8%	17.7%	21.8%
0-2 PCEs | Highest 60-80% income	13.8%	12.0%	15.5%
0-2 PCEs | Highest 80-100% income	9.0%	7.6%	10.4%
3 PCEs | Lowest 20% income	26.7%	24.3%	29.0%
3 PCEs | Lowest 20-40% income	25.2%	22.7%	27.6%
3 PCEs | Middle 40-60%	25.3%	23.1%	27.6%
3 PCEs | Highest 60-80% income	22.7%	20.8%	24.6%
3 PCEs | Highest 80-100% income	20.6%	18.7%	22.6%
4 PCEs | Lowest 20% income	21.9%	19.6%	24.2%
4 PCEs | Lowest 20-40% income	23.3%	21.2%	25.4%
4 PCEs | Middle 40-60%	26.3%	24.1%	28.4%
4 PCEs | Highest 60-80% income	27.7%	25.5%	30.0%
4 PCEs | Highest 80-100% income	27.9%	25.8%	30.0%
5 PCEs | Lowest 20% income	12.0%	10.3%	13.7%
5 PCEs | Lowest 20-40% income	14.8%	13.3%	16.4%
5 PCEs | Middle 40-60%	16.7%	14.9%	18.5%
5 PCEs | Highest 60-80% income	21.0%	19.1%	23.0%
5 PCEs | Highest 80-100% income	24.2%	22.3%	26.1%
6-7 PCEs | Lowest 20% income	6.9%	5.3%	8.4%
6-7 PCEs | Lowest 20-40% income	8.8%	7.4%	10.3%
6-7 PCEs | Middle 40-60%	12.0%	9.9%	14.0%
6-7 PCEs | Highest 60-80% income	14.7%	12.6%	16.8%
6-7 PCEs | Highest 80-100% income	18.3%	15.8%	20.7%

Table A3.0.11: PCEs | by education

	Prop	95% CI lower	95% CI upper
0-2 PCEs | No qualifications	32.5%	28.8%	36.3%
0-2 PCEs | NVQ level 1	30.4%	26.2%	34.5%
0-2 PCEs | NVQ level 2	23.5%	21.5%	25.5%
0-2 PCEs | NVQ level 3	18.9%	16.8%	21.0%
0-2 PCEs | NVQ level 4	13.2%	11.9%	14.6%
0-2 PCEs | NVQ level 5	8.7%	6.4%	11.0%
3 PCEs | No qualifications	26.1%	23.0%	29.3%
3 PCEs | NVQ level 1	24.2%	20.2%	28.3%
3 PCEs | NVQ level 2	25.0%	23.0%	27.1%
3 PCEs | NVQ level 3	24.7%	22.2%	27.2%
3 PCEs | NVQ level 4	22.5%	20.9%	24.1%
3 PCEs | NVQ level 5	20.2%	17.1%	23.4%
4 PCEs | No qualifications	21.2%	18.2%	24.2%
4 PCEs | NVQ level 1	23.2%	19.5%	27.0%
4 PCEs | NVQ level 2	25.0%	23.0%	26.9%
4 PCEs | NVQ level 3	27.0%	24.6%	29.5%

4 PCEs | NVQ level 4	27.2%	25.3%	29.1%
4 PCEs | NVQ level 5	26.5%	23.1%	30.0%
5 PCEs | No qualifications	13.1%	10.6%	15.6%
5 PCEs | NVQ level 1	13.2%	10.2%	16.3%
5 PCEs | NVQ level 2	16.0%	14.3%	17.6%
5 PCEs | NVQ level 3	17.6%	15.5%	19.7%
5 PCEs | NVQ level 4	21.7%	20.0%	23.3%
5 PCEs | NVQ level 5	24.2%	20.6%	27.9%
6-7 PCEs | No qualifications	7.0%	5.1%	8.9%
6-7 PCEs | NVQ level 1	8.9%	6.6%	11.3%
6-7 PCEs | NVQ level 2	10.5%	9.0%	12.0%
6-7 PCEs | NVQ level 3	11.7%	9.4%	14.1%
6-7 PCEs | NVQ level 4	15.4%	13.6%	17.2%
6-7 PCEs | NVQ level 5	20.3%	16.5%	24.0%

Table A3.0.12: PCEs | by country

	Prop	95% CI lower	95% CI upper
0-2 PCEs | England	19.0%	17.8%	20.2%
0-2 PCEs | Wales	18.9%	16.6%	21.2%
3 PCEs | England	24.1%	23.0%	25.2%
3 PCEs | Wales	22.3%	20.0%	24.6%
4 PCEs | England	25.7%	24.4%	27.0%
4 PCEs | Wales	26.3%	24.0%	28.6%
5 PCEs | England	18.6%	17.5%	19.6%
5 PCEs | Wales	18.5%	16.3%	20.8%
6-7 PCEs | England	12.6%	11.2%	14.0%
6-7 PCEs | Wales	13.9%	11.6%	16.3%

Table A3.0.13: Neighbourhood violent crime | by ethnicity

	Prop	95% CI lower	95% CI upper
Lowest 20% neighbourhood violence | White	0.274	0.245	0.303
Lowest 20% neighbourhood violence | Mixed	0.139	0.098	0.180
Lowest 20% neighbourhood violence | Asian	0.082	0.055	0.109
Lowest 20% neighbourhood violence | Black	0.054	0.014	0.095
Lowest 20% neighbourhood violence | Other	0.096	0.027	0.165
Lowest 20-40% neighbourhood violence | White	0.241	0.221	0.261
Lowest 20-40% neighbourhood violence | Mixed	0.199	0.157	0.242
Lowest 20-40% neighbourhood violence | Asian	0.137	0.095	0.178
Lowest 20-40% neighbourhood violence | Black	0.058	0.032	0.084
Lowest 20-40% neighbourhood violence | Other	0.146	0.047	0.244
Middle 40-60% neighbourhood violence | White	0.194	0.174	0.214
Middle 40-60% neighbourhood violence | Mixed	0.231	0.188	0.274
Middle 40-60% neighbourhood violence | Asian	0.220	0.176	0.264
Middle 40-60% neighbourhood violence | Black	0.182	0.136	0.228
Middle 40-60% neighbourhood violence | Other	0.202	0.114	0.289

	Prop	95% CI lower	95% CI upper
Highest 60-80% neighbourhood violence | White	0.157	0.140	0.174
Highest 60-80% neighbourhood violence | Mixed	0.205	0.166	0.243
Highest 60-80% neighbourhood violence | Asian	0.270	0.224	0.317
Highest 60-80% neighbourhood violence | Black	0.256	0.181	0.331
Highest 60-80% neighbourhood violence | Other	0.283	0.167	0.399
Highest 80-100% neighbourhood violence | White	0.134	0.116	0.152
Highest 80-100% neighbourhood violence | Mixed	0.225	0.172	0.279
Highest 80-100% neighbourhood violence | Asian	0.291	0.227	0.356
Highest 80-100% neighbourhood violence | Black	0.451	0.392	0.509
Highest 80-100% neighbourhood violence | Other	0.273	0.181	0.365

Table A3.0.14: Neighbourhood violent crime | by maternal age at birth

	Prop	95% CI lower	95% CI upper
Lowest 20% neighbourhood violence | Under 20	0.112	0.087	0.137
Lowest 20% neighbourhood violence | 20 to 24	0.157	0.134	0.179
Lowest 20% neighbourhood violence | 25 to 29	0.246	0.218	0.275
Lowest 20% neighbourhood violence | 30 to 35	0.313	0.278	0.348
Lowest 20% neighbourhood violence | 36 or over	0.305	0.264	0.347
Lowest 20-40% neighbourhood violence | Under 20	0.197	0.167	0.228
Lowest 20-40% neighbourhood violence | 20 to 24	0.187	0.162	0.212
Lowest 20-40% neighbourhood violence | 25 to 29	0.231	0.209	0.253
Lowest 20-40% neighbourhood violence | 30 to 35	0.248	0.224	0.271
Lowest 20-40% neighbourhood violence | 36 or over	0.238	0.207	0.269
Middle 40-60% neighbourhood violence | Under 20	0.219	0.185	0.254
Middle 40-60% neighbourhood violence | 20 to 24	0.197	0.174	0.220
Middle 40-60% neighbourhood violence | 25 to 29	0.213	0.189	0.237
Middle 40-60% neighbourhood violence | 30 to 35	0.180	0.159	0.201
Middle 40-60% neighbourhood violence | 36 or over	0.194	0.164	0.224
Highest 60-80% neighbourhood violence | Under 20	0.223	0.192	0.253
Highest 60-80% neighbourhood violence | 20 to 24	0.220	0.195	0.246
Highest 60-80% neighbourhood violence | 25 to 29	0.166	0.146	0.186
Highest 60-80% neighbourhood violence | 30 to 35	0.144	0.126	0.163
Highest 60-80% neighbourhood violence | 36 or over	0.141	0.118	0.165
Highest 80-100% neighbourhood violence | Under 20	0.249	0.208	0.290
Highest 80-100% neighbourhood violence | 20 to 24	0.239	0.208	0.270
Highest 80-100% neighbourhood violence | 25 to 29	0.144	0.123	0.164
Highest 80-100% neighbourhood violence | 30 to 35	0.115	0.096	0.133
Highest 80-100% neighbourhood violence | 36 or over	0.121	0.100	0.143

Table A3.0.15: Neighbourhood violent crime | by household income

	Prop	95% CI lower	95% CI upper
Lowest 20% neighbourhood violence | Lowest 20% income	0.082	0.064	0.101
Lowest 20% neighbourhood violence | Lowest 20-40% income	0.128	0.104	0.152
Lowest 20% neighbourhood violence | Middle 40-60%	0.214	0.183	0.244
Lowest 20% neighbourhood violence | Highest 60-80% income	0.300	0.262	0.339
Lowest 20% neighbourhood violence | Highest 80-100% income	0.418	0.377	0.460
Lowest 20-40% neighbourhood violence | Lowest 20% income	0.141	0.113	0.169
Lowest 20-40% neighbourhood violence | Lowest 20-40% income	0.184	0.159	0.209

	Prop	95% CI lower	95% CI upper
Lowest 20-40% neighbourhood violence | Middle 40-60%	0.236	0.208	0.265
Lowest 20-40% neighbourhood violence | Highest 60-80% income	0.252	0.225	0.279
Lowest 20-40% neighbourhood violence | Highest 80-100% income	0.280	0.254	0.306
Middle 40-60% neighbourhood violence | Lowest 20% income	0.207	0.177	0.237
Middle 40-60% neighbourhood violence | Lowest 20-40% income	0.216	0.190	0.242
Middle 40-60% neighbourhood violence | Middle 40-60%	0.213	0.186	0.241
Middle 40-60% neighbourhood violence | Highest 60-80% income	0.209	0.181	0.236
Middle 40-60% neighbourhood violence | Highest 80-100% income	0.154	0.131	0.178
Highest 60-80% neighbourhood violence | Lowest 20% income	0.257	0.227	0.288
Highest 60-80% neighbourhood violence | Lowest 20-40% income	0.229	0.201	0.256
Highest 60-80% neighbourhood violence | Middle 40-60%	0.176	0.153	0.198
Highest 60-80% neighbourhood violence | Highest 60-80% income	0.148	0.124	0.172
Highest 60-80% neighbourhood violence | Highest 80-100% income	0.090	0.074	0.107
Highest 80-100% neighbourhood violence | Lowest 20% income	0.312	0.271	0.354
Highest 80-100% neighbourhood violence | Lowest 20-40% income	0.243	0.211	0.276
Highest 80-100% neighbourhood violence | Middle 40-60%	0.161	0.136	0.185
Highest 80-100% neighbourhood violence | Highest 60-80% income	0.091	0.074	0.108
Highest 80-100% neighbourhood violence | Highest 80-100% income	0.057	0.043	0.072

Table A3.0.16: Neighbourhood violent crime | by education

	Prop	95% CI lower	95% CI upper
Lowest 20% neighbourhood violence | No qualifications	0.069	0.050	0.088
Lowest 20% neighbourhood violence | NVQ level 1	0.127	0.098	0.157
Lowest 20% neighbourhood violence | NVQ level 2	0.181	0.154	0.208
Lowest 20% neighbourhood violence | NVQ level 3	0.248	0.215	0.281
Lowest 20% neighbourhood violence | NVQ level 4	0.330	0.297	0.364
Lowest 20% neighbourhood violence | NVQ level 5	0.395	0.340	0.449
Lowest 20-40% neighbourhood violence | No qualifications	0.141	0.112	0.169
Lowest 20-40% neighbourhood violence | NVQ level 1	0.190	0.155	0.225
Lowest 20-40% neighbourhood violence | NVQ level 2	0.211	0.186	0.236
Lowest 20-40% neighbourhood violence | NVQ level 3	0.224	0.196	0.252
Lowest 20-40% neighbourhood violence | NVQ level 4	0.261	0.239	0.284
Lowest 20-40% neighbourhood violence | NVQ level 5	0.250	0.213	0.287
Middle 40-60% neighbourhood violence | No qualifications	0.202	0.169	0.236
Middle 40-60% neighbourhood violence | NVQ level 1	0.197	0.163	0.230
Middle 40-60% neighbourhood violence | NVQ level 2	0.219	0.194	0.244
Middle 40-60% neighbourhood violence | NVQ level 3	0.211	0.185	0.238
Middle 40-60% neighbourhood violence | NVQ level 4	0.179	0.157	0.201
Middle 40-60% neighbourhood violence | NVQ level 5	0.175	0.143	0.208
Highest 60-80% neighbourhood violence | No qualifications	0.272	0.238	0.307
Highest 60-80% neighbourhood violence | NVQ level 1	0.240	0.209	0.270
Highest 60-80% neighbourhood violence | NVQ level 2	0.195	0.172	0.218
Highest 60-80% neighbourhood violence | NVQ level 3	0.169	0.145	0.192
Highest 60-80% neighbourhood violence | NVQ level 4	0.132	0.114	0.149
Highest 60-80% neighbourhood violence | NVQ level 5	0.100	0.079	0.121
Highest 80-100% neighbourhood violence | No qualifications	0.316	0.270	0.362
Highest 80-100% neighbourhood violence | NVQ level 1	0.246	0.207	0.286
Highest 80-100% neighbourhood violence | NVQ level 2	0.194	0.168	0.221
Highest 80-100% neighbourhood violence | NVQ level 3	0.148	0.125	0.172
Highest 80-100% neighbourhood violence | NVQ level 4	0.098	0.083	0.113
Highest 80-100% neighbourhood violence | NVQ level 5	0.080	0.054	0.106

Table A3.0.17: Neighbourhood violent crime | by country

	Prop	95% CI lower	95% CI upper
Lowest 20% neighbourhood violence | England	0.240	0.213	0.267
Lowest 20% neighbourhood violence | Wales	0.290	0.218	0.361
Lowest 20-40% neighbourhood violence | England	0.228	0.206	0.249
Lowest 20-40% neighbourhood violence | Wales	0.227	0.188	0.266
Middle 40-60% neighbourhood violence | England	0.200	0.180	0.221
Middle 40-60% neighbourhood violence | Wales	0.185	0.141	0.229
Highest 60-80% neighbourhood violence | England	0.176	0.157	0.194
Highest 60-80% neighbourhood violence | Wales	0.146	0.109	0.183
Highest 80-100% neighbourhood violence | England	0.156	0.136	0.177
Highest 80-100% neighbourhood violence | Wales	0.152	0.111	0.194

Table A3.0.18: Neighbourhood general crime | by ethnicity

	Prop	95% CI lower	95% CI upper
Lowest 20% neighbourhood general crime | White	0.266	0.237	0.295
Lowest 20% neighbourhood general crime | Mixed	0.125	0.091	0.159
Lowest 20% neighbourhood general crime | Asian	0.122	0.093	0.151
Lowest 20% neighbourhood general crime | Black	0.067	0.025	0.109
Lowest 20% neighbourhood general crime | Other	0.125	0.050	0.201
Lowest 20-40% neighbourhood general crime | White	0.223	0.204	0.241
Lowest 20-40% neighbourhood general crime | Mixed	0.206	0.166	0.246
Lowest 20-40% neighbourhood general crime | Asian	0.151	0.117	0.185
Lowest 20-40% neighbourhood general crime | Black	0.132	0.096	0.167
Lowest 20-40% neighbourhood general crime | Other	0.200	0.104	0.296
Middle 40-60% neighbourhood general crime | White	0.196	0.174	0.218
Middle 40-60% neighbourhood general crime | Mixed	0.245	0.196	0.293
Middle 40-60% neighbourhood general crime | Asian	0.210	0.153	0.267
Middle 40-60% neighbourhood general crime | Black	0.181	0.122	0.240
Middle 40-60% neighbourhood general crime | Other	0.170	0.080	0.259
Highest 60-80% neighbourhood general crime | White	0.167	0.149	0.185
Highest 60-80% neighbourhood general crime | Mixed	0.198	0.158	0.238
Highest 60-80% neighbourhood general crime | Asian	0.248	0.177	0.320
Highest 60-80% neighbourhood general crime | Black	0.271	0.222	0.321
Highest 60-80% neighbourhood general crime | Other	0.283	0.177	0.389
Highest 80-100% neighbourhood general crime | White	0.148	0.128	0.167
Highest 80-100% neighbourhood general crime | Mixed	0.226	0.181	0.271
Highest 80-100% neighbourhood general crime | Asian	0.270	0.198	0.342
Highest 80-100% neighbourhood general crime | Black	0.349	0.292	0.405
Highest 80-100% neighbourhood general crime | Other	0.222	0.121	0.322

Table A3.0.19: Neighbourhood general crime | by maternal age

	Prop	95% CI lower	95% CI upper
Lowest 20% neighbourhood general crime | Under 20	0.139	0.110	0.167
Lowest 20% neighbourhood general crime | 20 to 24	0.163	0.139	0.187
Lowest 20% neighbourhood general crime | 25 to 29	0.247	0.221	0.274
Lowest 20% neighbourhood general crime | 30 to 35	0.299	0.264	0.335
Lowest 20% neighbourhood general crime | 36 or over	0.282	0.237	0.326
Lowest 20-40% neighbourhood general crime | Under 20	0.167	0.138	0.196
Lowest 20-40% neighbourhood general crime | 20 to 24	0.173	0.152	0.194
Lowest 20-40% neighbourhood general crime | 25 to 29	0.221	0.200	0.243
Lowest 20-40% neighbourhood general crime | 30 to 35	0.237	0.215	0.260
Lowest 20-40% neighbourhood general crime | 36 or over	0.228	0.199	0.258
Middle 40-60% neighbourhood general crime | Under 20	0.203	0.175	0.232
Middle 40-60% neighbourhood general crime | 20 to 24	0.209	0.184	0.234
Middle 40-60% neighbourhood general crime | 25 to 29	0.202	0.176	0.229
Middle 40-60% neighbourhood general crime | 30 to 35	0.189	0.164	0.213
Middle 40-60% neighbourhood general crime | 36 or over	0.197	0.166	0.228
Highest 60-80% neighbourhood general crime | Under 20	0.220	0.188	0.252
Highest 60-80% neighbourhood general crime | 20 to 24	0.216	0.195	0.238
Highest 60-80% neighbourhood general crime | 25 to 29	0.179	0.158	0.201
Highest 60-80% neighbourhood general crime | 30 to 35	0.153	0.131	0.175
Highest 60-80% neighbourhood general crime | 36 or over	0.155	0.128	0.182
Highest 80-100% neighbourhood general crime | Under 20	0.271	0.228	0.314
Highest 80-100% neighbourhood general crime | 20 to 24	0.239	0.208	0.270
Highest 80-100% neighbourhood general crime | 25 to 29	0.150	0.127	0.172
Highest 80-100% neighbourhood general crime | 30 to 35	0.121	0.105	0.138
Highest 80-100% neighbourhood general crime | 36 or over	0.138	0.115	0.161

Table A3.0.20: Neighbourhood general crime | by household income

	Prop	95% CI lower	95% CI upper
Lowest 20% neighbourhood general crime | Lowest 20% income	0.098	0.078	0.119
Lowest 20% neighbourhood general crime | Lowest 20-40% income	0.142	0.118	0.167
Lowest 20% neighbourhood general crime | Middle 40-60%	0.226	0.194	0.258
Lowest 20% neighbourhood general crime | Highest 60-80% income	0.303	0.263	0.343
Lowest 20% neighbourhood general crime | Highest 80-100% income	0.371	0.328	0.413
Lowest 20-40% neighbourhood general crime | Lowest 20% income	0.137	0.114	0.160
Lowest 20-40% neighbourhood general crime | Lowest 20-40% income	0.177	0.152	0.202
Lowest 20-40% neighbourhood general crime | Middle 40-60%	0.216	0.191	0.242
Lowest 20-40% neighbourhood general crime | Highest 60-80% income	0.235	0.211	0.260
Lowest 20-40% neighbourhood general crime | Highest 80-100% income	0.268	0.238	0.298
Middle 40-60% neighbourhood general crime | Lowest 20% income	0.194	0.165	0.223
Middle 40-60% neighbourhood general crime | Lowest 20-40% income	0.208	0.180	0.237
Middle 40-60% neighbourhood general crime | Middle 40-60%	0.217	0.189	0.245
Middle 40-60% neighbourhood general crime | Highest 60-80% income	0.201	0.170	0.233
Middle 40-60% neighbourhood general crime | Highest 80-100% income	0.176	0.152	0.200
Highest 60-80% neighbourhood general crime | Lowest 20% income	0.255	0.222	0.287
Highest 60-80% neighbourhood general crime | Lowest 20-40% income	0.232	0.204	0.259
Highest 60-80% neighbourhood general crime | Middle 40-60%	0.173	0.151	0.195
Highest 60-80% neighbourhood general crime | Highest 60-80% income	0.163	0.136	0.189

	Prop	95% CI lower	95% CI upper
Highest 60-80% neighbourhood general crime | Highest 80-100% income	0.109	0.086	0.133
Highest 80-100% neighbourhood general crime | Lowest 20% income	0.317	0.273	0.360
Highest 80-100% neighbourhood general crime | Lowest 20-40% income	0.241	0.208	0.273
Highest 80-100% neighbourhood general crime | Middle 40-60%	0.168	0.143	0.193
Highest 80-100% neighbourhood general crime | Highest 60-80% income	0.098	0.080	0.115
Highest 80-100% neighbourhood general crime | Highest 80-100% income	0.076	0.060	0.093

Table A3.0.21: Neighbourhood general crime | by education

	Prop	95% CI lower	95% CI upper
Lowest 20% neighbourhood general crime | No qualifications	0.090	0.066	0.114
Lowest 20% neighbourhood general crime | NVQ level 1	0.134	0.102	0.165
Lowest 20% neighbourhood general crime | NVQ level 2	0.190	0.163	0.217
Lowest 20% neighbourhood general crime | NVQ level 3	0.248	0.214	0.282
Lowest 20% neighbourhood general crime | NVQ level 4	0.315	0.281	0.350
Lowest 20% neighbourhood general crime | NVQ level 5	0.352	0.300	0.405
Lowest 20-40% neighbourhood general crime | No qualifications	0.144	0.118	0.170
Lowest 20-40% neighbourhood general crime | NVQ level 1	0.175	0.144	0.206
Lowest 20-40% neighbourhood general crime | NVQ level 2	0.204	0.178	0.230
Lowest 20-40% neighbourhood general crime | NVQ level 3	0.197	0.174	0.220
Lowest 20-40% neighbourhood general crime | NVQ level 4	0.249	0.226	0.272
Lowest 20-40% neighbourhood general crime | NVQ level 5	0.237	0.202	0.271
Middle 40-60% neighbourhood general crime | No qualifications	0.194	0.161	0.227
Middle 40-60% neighbourhood general crime | NVQ level 1	0.201	0.160	0.241
Middle 40-60% neighbourhood general crime | NVQ level 2	0.207	0.179	0.235
Middle 40-60% neighbourhood general crime | NVQ level 3	0.226	0.196	0.256
Middle 40-60% neighbourhood general crime | NVQ level 4	0.184	0.164	0.204
Middle 40-60% neighbourhood general crime | NVQ level 5	0.183	0.149	0.216
Highest 60-80% neighbourhood general crime | No qualifications	0.260	0.224	0.295
Highest 60-80% neighbourhood general crime | NVQ level 1	0.233	0.194	0.272
Highest 60-80% neighbourhood general crime | NVQ level 2	0.205	0.182	0.228
Highest 60-80% neighbourhood general crime | NVQ level 3	0.166	0.145	0.188
Highest 60-80% neighbourhood general crime | NVQ level 4	0.148	0.127	0.168
Highest 60-80% neighbourhood general crime | NVQ level 5	0.114	0.086	0.142
Highest 80-100% neighbourhood general crime | No qualifications	0.313	0.266	0.359
Highest 80-100% neighbourhood general crime | NVQ level 1	0.258	0.216	0.299
Highest 80-100% neighbourhood general crime | NVQ level 2	0.194	0.167	0.222
Highest 80-100% neighbourhood general crime | NVQ level 3	0.162	0.138	0.187
Highest 80-100% neighbourhood general crime | NVQ level 4	0.105	0.090	0.120
Highest 80-100% neighbourhood general crime | NVQ level 5	0.115	0.085	0.144

Table A3.0.22: Neighbourhood general crime | by country

	Prop	95% CI lower	95% CI upper
Lowest 20% neighbourhood general crime | England	0.238	0.208	0.268
Lowest 20% neighbourhood general crime | Wales	0.278	0.220	0.336
Lowest 20-40% neighbourhood general crime | England	0.229	0.209	0.249
Lowest 20-40% neighbourhood general crime | Wales	0.163	0.130	0.195
Middle 40-60% neighbourhood general crime | England	0.190	0.167	0.214
Middle 40-60% neighbourhood general crime | Wales	0.227	0.188	0.265

		95% CI lower	95% CI upper
Highest 60-80% neighbourhood general crime | England	0.177	0.158	0.196
Highest 60-80% neighbourhood general crime | Wales	0.177	0.133	0.222
Highest 80-100% neighbourhood general crime | England	0.166	0.143	0.188
Highest 80-100% neighbourhood general crime | Wales	0.155	0.118	0.193

Table A3.0.23: ACEs | by neighbourhood general crime

	Prop	95% CI lower	95% CI upper
No ACEs | Lowest 20% neighbourhood general crime	25.4%	23.4%	27.5%
No ACEs | Lowest 20-40% neighbourhood general crime	22.2%	20.1%	24.4%
No ACEs | Middle 40-60% neighbourhood general crime	18.3%	16.4%	20.3%
No ACEs | Highest 60-80% neighbourhood general crime	15.3%	13.4%	17.3%
No ACEs | Highest 80-100% neighbourhood general crime	12.7%	10.8%	14.7%
One ACE | Lowest 20% neighbourhood general crime	25.9%	23.9%	27.8%
One ACE | Lowest 20-40% neighbourhood general crime	25.3%	23.3%	27.2%
One ACE | Middle 40-60% neighbourhood general crime	23.5%	21.4%	25.7%
One ACE | Highest 60-80% neighbourhood general crime	22.2%	19.9%	24.4%
One ACE | Highest 80-100% neighbourhood general crime	20.5%	18.6%	22.5%
Two ACEs | Lowest 20% neighbourhood general crime	21.2%	19.5%	22.9%
Two ACEs | Lowest 20-40% neighbourhood general crime	20.7%	18.6%	22.7%
Two ACEs | Middle 40-60% neighbourhood general crime	21.7%	19.7%	23.7%
Two ACEs | Highest 60-80% neighbourhood general crime	23.0%	20.7%	25.4%
Two ACEs | Highest 80-100% neighbourhood general crime	23.1%	21.2%	25.0%
Three ACEs | Lowest 20% neighbourhood general crime	13.4%	11.9%	14.9%
Three ACEs | Lowest 20-40% neighbourhood general crime	15.0%	13.2%	16.8%
Three ACEs | Middle 40-60% neighbourhood general crime	15.5%	13.8%	17.2%
Three ACEs | Highest 60-80% neighbourhood general crime	16.5%	14.8%	18.2%
Three ACEs | Highest 80-100% neighbourhood general crime	17.8%	15.7%	19.9%
Four ACEs | Lowest 20% neighbourhood general crime	8.0%	6.7%	9.3%
Four ACEs | Lowest 20-40% neighbourhood general crime	9.3%	7.7%	11.0%
Four ACEs | Middle 40-60% neighbourhood general crime	10.4%	9.0%	11.9%
Four ACEs | Highest 60-80% neighbourhood general crime	11.0%	9.4%	12.6%
Four ACEs | Highest 80-100% neighbourhood general crime	12.3%	10.7%	14.0%
Five ACEs | Lowest 20% neighbourhood general crime	3.9%	3.0%	4.9%
Five ACEs | Lowest 20-40% neighbourhood general crime	4.4%	3.5%	5.3%
Five ACEs | Middle 40-60% neighbourhood general crime	5.9%	4.7%	7.1%
Five ACEs | Highest 60-80% neighbourhood general crime	6.0%	4.8%	7.2%
Five ACEs | Highest 80-100% neighbourhood general crime	7.4%	6.0%	8.8%
Six or more ACEs | Lowest 20% neighbourhood general crime	2.2%	1.6%	2.8%
Six or more ACEs | Lowest 20-40% neighbourhood general crime	3.1%	2.3%	3.9%
Six or more ACEs | Middle 40-60% neighbourhood general crime	4.6%	3.6%	5.6%
Six or more ACEs | Highest 60-80% neighbourhood general crime	5.9%	4.7%	7.1%
Six or more ACEs | Highest 80-100% neighbourhood general crime	6.1%	4.7%	7.4%

Table A3.0.24: PCEs | by neighbourhood general crime

	Prop	95% CI lower	95% CI upper
0-2 PCEs | Lowest 20% neighbourhood general crime	13.0%	11.3%	14.7%
0-2 PCEs | Lowest 20-40% neighbourhood general crime	16.0%	14.0%	18.0%
0-2 PCEs | Middle 40-60% neighbourhood general crime	19.6%	17.4%	21.8%
0-2 PCEs | Highest 60-80% neighbourhood general crime	23.5%	21.3%	25.8%
0-2 PCEs | Highest 80-100% neighbourhood general crime	26.2%	23.6%	28.8%
3 PCEs | Lowest 20% neighbourhood general crime	22.4%	20.3%	24.5%
3 PCEs | Lowest 20-40% neighbourhood general crime	23.0%	21.1%	24.9%
3 PCEs | Middle 40-60% neighbourhood general crime	24.2%	21.9%	26.5%
3 PCEs | Highest 60-80% neighbourhood general crime	25.5%	23.2%	27.8%
3 PCEs | Highest 80-100% neighbourhood general crime	24.2%	22.2%	26.2%
4 PCEs | Lowest 20% neighbourhood general crime	27.7%	25.3%	30.2%
4 PCEs | Lowest 20-40% neighbourhood general crime	26.9%	24.8%	28.9%
4 PCEs | Middle 40-60% neighbourhood general crime	25.9%	23.8%	28.1%
4 PCEs | Highest 60-80% neighbourhood general crime	23.8%	21.6%	26.1%
4 PCEs | Highest 80-100% neighbourhood general crime	23.7%	21.4%	25.9%
5 PCEs | Lowest 20% neighbourhood general crime	20.8%	19.1%	22.6%
5 PCEs | Lowest 20-40% neighbourhood general crime	20.2%	18.5%	22.0%
5 PCEs | Middle 40-60% neighbourhood general crime	17.8%	16.0%	19.6%
5 PCEs | Highest 60-80% neighbourhood general crime	16.9%	14.9%	19.0%
5 PCEs | Highest 80-100% neighbourhood general crime	15.6%	13.6%	17.5%
6-7 PCEs | Lowest 20% neighbourhood general crime	16.0%	13.9%	18.0%
6-7 PCEs | Lowest 20-40% neighbourhood general crime	13.9%	11.8%	16.0%
6-7 PCEs | Middle 40-60% neighbourhood general crime	12.4%	10.3%	14.6%
6-7 PCEs | Highest 60-80% neighbourhood general crime	10.2%	8.5%	12.0%
6-7 PCEs | Highest 80-100% neighbourhood general crime	10.3%	8.7%	12.0%

Appendix to RQ1-2

Table A3.1.1: ACEs and PCEs associations with youth violence (robustness checks)

	Assault perpetration		Weapon involvement		Gang involvement	
	RR	95% CI	RR	95% CI	RR	95% CI
ACEs						
None (ref)						
One ACE	1.09+	0.99 - 1.19	1.28+	0.96 - 1.71	1.43	0.89 - 2.31
Two ACEs	**1.18***	1.08 - 1.29	**1.61**	1.17 - 2.21	**1.63***	1.01 - 2.64
Three ACEs	**1.22***	1.11 - 1.35	**1.81***	1.29 - 2.54	**1.81***	1.13 - 2.90
Four ACEs	**1.23***	1.10 - 1.38	**1.94***	1.40 - 2.70	**1.85***	1.10 - 3.09
Five ACEs	**1.29***	1.14 - 1.47	**2.28***	1.55 - 3.36	**2.23**	1.32 - 3.76
Six or more ACEs	**1.38***	1.20 - 1.57	**2.49***	1.63 - 3.81	**2.33**	1.33 - 4.06
PCEs						
0-2 PCEs (ref)						
3 PCEs	**0.89**	0.84 - 0.96	**0.68***	0.58 - 0.81	**0.73**	0.60 - 0.90
4 PCEs	**0.84***	0.78 - 0.90	**0.53***	0.43 - 0.64	**0.58***	0.46 - 0.73
5 PCEs	**0.73***	0.67 - 0.80	**0.37***	0.27 - 0.50	**0.52***	0.38 - 0.69
6-7 PCEs	**0.65***	0.58 - 0.73	**0.34***	0.24 - 0.48	**0.42***	0.27 - 0.65
Neighbourhood violent crime						
Lowest 20% neighbourhood violent crime (ref)						
Lowest 20-40% neighbourhood violent crime	1.04	0.97 - 1.12	1.04	0.81 - 1.34	0.98	0.72 - 1.32
Middle 40-60% neighbourhood violent crime	1.03	0.95 - 1.11	1.06	0.83 - 1.35	0.92	0.71 - 1.21
Highest 60-80% neighbourhood violent crime	1.05	0.96 - 1.15	1.03	0.79 - 1.33	0.95	0.71 - 1.27
Highest 80-100% neighbourhood violent crime	1.03	0.93 - 1.14	1.06	0.81 - 1.39	0.93	0.67 - 1.30
Conduct problems age 3	**1.02***	1.00 - 1.03	1.00	0.96 - 1.04	1.04	0.99 - 1.09
Male	**1.83***	1.73 - 1.95	**2.74***	2.18 - 3.44	**1.41***	1.19 - 1.68
Ethnicity						
White (ref)						
Mixed	1.09	0.96 - 1.22	1.00	0.71 - 1.40	1.08	0.74 - 1.57
Asian	0.99	0.91 - 1.09	**0.73***	0.56 - 0.95	0.76	0.54 - 1.06
Black	**1.20**	1.06 - 1.35	0.72	0.46 - 1.11	0.71	0.40 - 1.26
Other	1.18	0.90 - 1.55	0.59	0.18 - 1.97	0.73	0.20 - 2.69
Maternal age at birth (years)	1.00	0.99 - 1.00	1.00	0.98 - 1.01	**0.98**	0.96 - 0.99
Household income (weekly £) sweep 9m to 11y	1.02+	1.00 - 1.04	0.94	0.86 - 1.03	**0.88***	0.80 - 0.98
Highest household education						
No qualifications (ref)						
NVQ1 (CGSEs graded less than C)	1.02	0.91 - 1.16	0.93	0.70 - 1.23	0.91	0.69 - 1.19
NVQ2 (CGSEs graded C or above)	1.04	0.94 - 1.15	0.92	0.71 - 1.19	0.79+	0.62 - 1.01
NVQ3 (A or AS level)	1.09	0.97 - 1.21	0.91	0.67 - 1.23	0.82	0.60 - 1.10
NVQ4 (Degree)	1.11+	1.00 - 1.24	0.91	0.63 - 1.31	0.73+	0.51 - 1.05
NVQ5 (Postgraduate)	**1.16***	1.00 - 1.34	0.78	0.45 - 1.33	0.54+	0.27 - 1.09
Highest household occupational status						
Managerial and professional (ref)						

	RR	95% CI	RR	95% CI	RR	95% CI
Intermediate	0.98	0.90 - 1.08	0.94	0.73 - 1.20	0.96	0.71 - 1.29
Small employers and self-employed	1.01	0.91 - 1.12	0.91	0.67 - 1.24	0.99	0.68 - 1.45
Low supervisory and technical	1.01	0.92 - 1.12	0.96	0.69 - 1.32	1.03	0.72 - 1.46
Semi-routine and routine	1.02	0.94 - 1.11	0.99	0.74 - 1.32	1.04	0.76 - 1.41
Single parent in number of sweeps (age 9m to 11y)						
Never (ref)						
One sweep	0.95	0.87 - 1.04	0.93	0.73 - 1.18	1.05	0.81 - 1.37
Two sweeps	1.06	0.96 - 1.16	1.02	0.76 - 1.35	1.04	0.74 - 1.44
Three sweeps	1.04	0.92 - 1.18	0.96	0.72 - 1.28	1.12	0.81 - 1.56
Four sweeps	1.08	0.96 - 1.20	1.24	0.95 - 1.63	1.24	0.87 - 1.76
All five sweeps	**1.12***	1.01 - 1.24	1.27+	0.97 - 1.65	1.33+	0.97 - 1.84
General neighbourhood deprivation (IMD domains)						
Income deprivation	0.97	0.90 - 1.06	0.88	0.71 - 1.09	0.94	0.70 - 1.25
Employment deprivation	0.99	0.91 - 1.07	1.14	0.89 - 1.46	1.15	0.86 - 1.52
Health deprivation	1.02	0.97 - 1.07	0.97	0.83 - 1.14	0.90	0.75 - 1.08
Educational deprivation	1.02	0.97 - 1.08	1.01	0.89 - 1.16	0.94	0.78 - 1.13

Notes: *** $p<0.001$, ** $p<0.01$, * $p<0.05$, + $p<0.10$

Table A3.1.2: ACEs and PCEs associations with youth violence (non imputed data)

	Assault perpetration		Weapon involvement		Gang involvement	
	RR	95% CI	RR	95% CI	RR	95% CI
ACEs						
None (ref)						
One ACE	**1.20***	1.04 - 1.39	1.33	0.76 - 2.30	2.06	0.71 - 5.96
Two ACEs	**1.34***	1.14 - 1.56	1.69+	0.99 - 2.88	2.38+	0.85 - 6.64
Three ACEs	**1.33**	1.12 - 1.59	1.56	0.84 - 2.89	**3.81***	1.35 - 10.75
Four ACEs	**1.23***	1.00 - 1.51	1.61	0.81 - 3.19	**3.96***	1.27 - 12.31
Five ACEs	1.19	0.91 - 1.56	**2.27***	1.05 - 4.90	2.62	0.70 - 9.72
Six or more ACEs	**1.32***	1.02 - 1.71	1.21	0.50 - 2.91	2.98+	0.85 - 10.47
PCEs						
0-2 PCEs (ref)						
3 PCEs	0.93	0.82 - 1.05	0.75	0.51 - 1.11	0.69	0.39 - 1.19
4 PCEs	0.89+	0.79 - 1.01	**0.56***	0.37 - 0.84	0.61+	0.34 - 1.09
5 PCEs	**0.75***	0.65 - 0.87	**0.28***	0.15 - 0.49	0.74	0.40 - 1.36
6-7 PCEs	**0.68***	0.58 - 0.80	**0.49***	0.29 - 0.81	0.54	0.25 - 1.14
Observations	6,901		4,865		4,930	

Notes: Adjusted for sex at birth, ethnicity, maternal age at birth, income, education, occupational status, and number of sweeps parent was single. *** $p<0.001$, ** $p<0.01$, * $p<0.05$, + $p<0.10$

Table A3.1.3: Risk ratio (RR) differences in assault perpetration between 3 or more vs 0 ACEs for different combinations of five single ACEs

	RR (0 vs 3 or more ACES)	95% CI low	95% CI high	P-value
10 highest RR (highest risk)				
Parental drug use Single parent Domestic violence Parental longterm disability/illness Physical abuse	1.399	1.253	1.562	0.000
Parental drug use Single parent Domestic violence Parental longterm disability/illness Verbal abuse	1.383	1.244	1.537	0.000
Parental drug use Single parent Domestic violence Parental longterm disability/illness Parental mental health	1.382	1.237	1.545	0.000
Parental drug use Single parent Domestic violence Parental alcohol abuse Parental longterm disability/illness	1.376	1.25	1.515	0.000
Parental drug use Single parent Parental alcohol abuse Parental longterm disability/illness Physical abuse	1.365	1.219	1.528	0.000
Parental drug use Single parent Domestic violence Parental alcohol abuse Physical abuse	1.36	1.233	1.5	0.000
Parental drug use Single parent Domestic violence Parental alcohol abuse Verbal abuse	1.355	1.227	1.497	0.000
Parental drug use Single parent Domestic violence Parental longterm disability/illness Poor parent-child relationship	1.355	1.209	1.519	0.000
Single parent Domestic violence Parental alcohol abuse Parental longterm disability/illness Physical abuse	1.354	1.221	1.501	0.000
Parental drug use Single parent Domestic violence Parental longterm disability/illness	1.352	1.223	1.494	0.000

Parental breakup				
10 lowest RR (lowest risk)				
Verbal abuse Parental mental health Parental breakup Poor parent-child relationship Poor parental relationship	1.13	1.023	1.248	0.016
Single parent Verbal abuse Parental mental health Parental breakup Poor parent-child relationship	1.129	1.005	1.269	0.042
Single parent Physical abuse Parental mental health Parental breakup Poor parental relationship	1.128	1	1.273	0.050
Parental longterm disability/illness Physical abuse Verbal abuse Parental mental health Poor parent-child relationship	1.127	1.007	1.261	0.037
Single parent Parental mental health Parental breakup Poor parent-child relationship Poor parental relationship	1.117	0.999	1.248	0.051
Single parent Physical abuse Parental mental health Poor parent-child relationship Poor parental relationship	1.114	0.996	1.246	0.059
Parental longterm disability/illness Physical abuse Parental mental health Parental breakup Poor parent-child relationship	1.114	0.991	1.252	0.071
Single parent Physical abuse Verbal abuse Parental mental health Poor parent-child relationship	1.097	0.983	1.223	0.098
Physical abuse Verbal abuse Parental mental health Parental breakup Poor parent-child relationship	1.096	0.984	1.221	0.094
Single parent Physical abuse Parental mental health Parental breakup Poor parent-child relationship	1.093	0.963	1.241	0.167

Notes: Each combination of five ACEs is examined in its own model. Adjust for sex at birth, ethnicity, maternal age at birth, income, education, occupational status, and number of sweeps parent was single, and PCEs.

Table A3.1.4: Risk ratio (RR) differences in weapon involvement between 3 or more vs 0 ACEs for different combinations of five single ACEs

	RR (0 vs 3 or more ACES)	95% CI low	95% CI high	P-value
10 highest RR (highest risk)				
Parental drug use Single parent Parental alcohol abuse Parental longterm disability/illness Physical abuse	2.426	1.801	3.268	0.000
Parental drug use Single parent Domestic violence Parental longterm disability/illness Physical abuse	2.391	1.844	3.102	0.000
Parental drug use Single parent Parental alcohol abuse Parental longterm disability/illness Parental breakup	2.319	1.746	3.079	0.000
Parental drug use Single parent Domestic violence Parental alcohol abuse Parental longterm disability/illness	2.306	1.789	2.974	0.000
Parental drug use Single parent Parental alcohol abuse Parental longterm disability/illness Verbal abuse	2.303	1.744	3.04	0.000
Parental drug use Single parent Parental alcohol abuse Parental longterm disability/illness Parental mental health	2.302	1.717	3.086	0.000
Parental drug use Single parent Domestic violence Parental alcohol abuse Physical abuse	2.298	1.742	3.032	0.000
Parental drug use Single parent Parental alcohol abuse Physical abuse Parental mental health	2.258	1.634	3.12	0.000
Parental drug use Single parent Parental longterm disability/illness Physical abuse Parental mental health	2.254	1.651	3.077	0.000

Parental drug use Single parent Parental longterm disability/illness Physical abuse Parental breakup	2.254	1.651	3.077	0.000
10 lowest RR (lowest risk)				
Parental longterm disability/illness Physical abuse Parental mental health Poor parent-child relationship Poor parental relationship	1.426	1.07	1.899	0.015
Parental alcohol abuse Verbal abuse Parental breakup Poor parent-child relationship Poor parental relationship	1.424	1.069	1.898	0.016
Single parent Physical abuse Verbal abuse Parental mental health Poor parental relationship	1.408	0.988	2.006	0.058
Parental longterm disability/illness Physical abuse Verbal abuse Parental mental health Poor parent-child relationship	1.384	1.028	1.863	0.032
Single parent Physical abuse Parental breakup Poor parent-child relationship Poor parental relationship	1.382	0.975	1.958	0.069
Physical abuse Verbal abuse Parental mental health Parental breakup Poor parent-child relationship	1.377	1	1.897	0.050
Single parent Verbal abuse Parental breakup Poor parent-child relationship Poor parental relationship	1.369	0.983	1.908	0.063
Physical abuse Verbal abuse Parental mental health Parental breakup Poor parental relationship	1.349	0.99	1.839	0.058
Single parent Physical abuse Parental mental health Poor parent-child relationship Poor parental relationship	1.325	0.905	1.938	0.148

Verbal abuse Parental mental health Parental breakup Poor parent-child relationship Poor parental relationship	1.310	0.971	1.768	0.077

Notes: Each combination of five ACEs is examined in its own model. Adjust for sex at birth, ethnicity, maternal age at birth, income, education, occupational status, and number of sweeps parent was single, and PCEs.

Table A3.1.5: Risk ratio (RR) differences in gang involvement between 3 or more vs 0 ACEs for different combinations of five single ACEs

	RR (0 vs 3 or more ACEs)	95% CI low	95% CI high	P-value
10 highest RR (highest risk)				
Parental drug use Single parent Domestic violence Verbal abuse Parental breakup	2.319	1.587	3.388	0.000
Parental drug use Single parent Domestic violence Parental longterm disability/illness Verbal abuse	2.307	1.578	3.374	0.000
Parental drug use Single parent Physical abuse Verbal abuse Parental breakup	2.292	1.54	3.411	0.000
Parental drug use Single parent Domestic violence Parental longterm disability/illness Physical abuse	2.27	1.604	3.211	0.000
Parental drug use Single parent Domestic violence Physical abuse Parental breakup	2.268	1.559	3.3	0.000
Parental drug use Single parent Parental alcohol abuse Parental longterm disability/illness Verbal abuse	2.257	1.579	3.227	0.000
Parental drug use Single parent Parental longterm disability/illness Verbal abuse Parental breakup	2.257	1.524	3.342	0.000
Parental drug use Single parent Physical abuse Parental breakup Poor parent-child relationship	2.243	1.456	3.455	0.000

Parental drug use Single parent Domestic violence Physical abuse Poor parent-child relationship	2.225	1.501	3.299	0.000
Parental drug use Single parent Domestic violence Parental longterm disability/illness Poor parent-child relationship	2.223	1.524	3.243	0.000
10 lowest RR (lowest risk)				
Parental alcohol abuse Physical abuse Parental mental health Parental breakup Poor parental relationship	1.373	0.963	1.958	0.080
Parental alcohol abuse Parental longterm disability/illness Parental mental health Poor parent-child relationship Poor parental relationship	1.371	1.016	1.849	0.039
Parental alcohol abuse Parental longterm disability/illness Parental mental health Parental breakup Poor parental relationship	1.356	1.009	1.823	0.043
Parental longterm disability/illness Physical abuse Parental mental health Parental breakup Poor parental relationship	1.356	0.958	1.919	0.086
Parental alcohol abuse Parental mental health Parental breakup Poor parent-child relationship Poor parental relationship	1.352	0.957	1.91	0.087
Single parent Physical abuse Parental mental health Poor parent-child relationship Poor parental relationship	1.345	0.822	2.203	0.238
Single parent Parental longterm disability/illness Physical abuse Parental mental health Poor parental relationship	1.337	0.86	2.078	0.197
Single parent Parental longterm disability/illness Parental mental health Poor parent-child relationship Poor parental relationship	1.337	0.875	2.045	0.180
Parental longterm disability/illness Physical abuse Verbal abuse	1.312	0.887	1.942	0.174

Parental mental health Poor parental relationship				
Parental longterm disability/illness Physical abuse Parental mental health Poor parent-child relationship Poor parental relationship	1.287	0.892	1.857	0.178

Notes: Each combination of five ACEs is examined in its own model. Adjust for sex at birth, ethnicity, maternal age at birth, income, education, occupational status, and number of sweeps parent was single, and PCEs.

Table A3.2.1: Risk ratio (RR) differences in assault perpetration between 3 or more vs 0 PCEs for different combinations of PCEs

	RR (0 vs 3 or more PCEs)	95% CI low	95% CI high	P-value
10 lowest RR (highest reduction)				
Low-risk peers Good school connectedness Positive teacher-child relationship Positive peer experiences	0.628	0.569	0.692	0.000
Low-risk peers Good school connectedness Positive peer experiences Feeling safe in playground	0.635	0.574	0.702	0.000
Low-risk peers Good school connectedness Positive peer experiences Safe neighbourhood	0.637	0.566	0.718	0.000
Low-risk peers Good school connectedness Positive peer experiences Activities and hobbies	0.644	0.576	0.72	0.000
Low-risk peers Good school connectedness Positive teacher-child relationship Feeling safe in playground	0.656	0.595	0.724	0.000
Low-risk peers Positive teacher-child relationship Positive peer experiences Safe neighbourhood	0.658	0.59	0.734	0.000
Low-risk peers Positive teacher-child relationship Positive peer experiences Feeling safe in playground	0.66	0.597	0.729	0.000
Low-risk peers Good school connectedness Positive teacher-child relationship Safe neighbourhood	0.664	0.596	0.738	0.000
Low-risk peers Good school connectedness Positive teacher-child relationship Activities and hobbies	0.677	0.607	0.755	0.000

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Good school connectedness Positive teacher-child relationship Positive peer experiences Safe neighbourhood	0.678	0.617	0.746	0.000
10 largest RR (lowest reduction)				
Positive teacher-child relationship Positive peer experiences Feeling safe in playground Safe neighbourhood	0.716	0.651	0.787	0.000
Positive teacher-child relationship Positive peer experiences Feeling safe in playground Safe neighbourhood	0.718	0.636	0.811	0.000
Low-risk peers Positive teacher-child relationship Feeling safe in playground Activities and hobbies	0.73	0.663	0.803	0.000
Good school connectedness Positive peer experiences Feeling safe in playground Activities and hobbies	0.738	0.669	0.813	0.000
Positive teacher-child relationship Positive peer experiences Safe neighbourhood Activities and hobbies	0.741	0.668	0.821	0.000
Good school connectedness Positive teacher-child relationship Feeling safe in playground Activities and hobbies	0.744	0.678	0.817	0.000
Good school connectedness Positive teacher-child relationship Safe neighbourhood Activities and hobbies	0.746	0.679	0.821	0.000
Positive teacher-child relationship Positive peer experiences Feeling safe in playground Activities and hobbies	0.751	0.676	0.834	0.000
Good school connectedness Feeling safe in playground Safe neighbourhood Activities and hobbies	0.755	0.678	0.841	0.000
Positive peer experiences Feeling safe in playground Safe neighbourhood Activities and hobbies	0.77	0.688	0.862	0.000

Notes: Each combination of four PCEs is examined in its own model. Adjust for sex at birth, ethnicity, maternal age at birth, income, education, occupational status, and number of sweeps parent was single, and ACEs.

Table A3.2.2: Risk ratio (RR) differences in weapon involvement between 3 or more vs 0 PCEs for different combinations of PCEs

	RR (0 vs 3 or more PCEs)	95% CI low	95% CI high	P-value
10 lowest RR (highest reduction)				
Low-risk peers Good school connectedness Positive teacher-child relationship Positive peer experiences	0.262	0.196	0.351	0.000
Low-risk peers Good school connectedness Positive teacher-child relationship Feeling safe in playground	0.268	0.2	0.36	0.000
Low-risk peers Good school connectedness Positive teacher-child relationship Safe neighbourhood	0.269	0.201	0.36	0.000
Low-risk peers Good school connectedness Positive teacher-child relationship Activities and hobbies	0.27	0.199	0.368	0.000
Low-risk peers Positive teacher-child relationship Positive peer experiences Activities and hobbies	0.274	0.208	0.363	0.000
Low-risk peers Positive teacher-child relationship Positive peer experiences Safe neighbourhood	0.281	0.215	0.368	0.000
Low-risk peers Good school connectedness Positive peer experiences Activities and hobbies	0.285	0.214	0.381	0.000
Low-risk peers Positive teacher-child relationship Positive peer experiences Feeling safe in playground	0.289	0.223	0.375	0.000
Low-risk peers Good school connectedness Positive peer experiences Safe neighbourhood	0.296	0.228	0.385	0.000
Low-risk peers Good school connectedness Positive peer experiences Feeling safe in playground	0.305	0.234	0.398	0.000
10 highest RR (lowest reduction)				
Positive teacher-child relationship Positive peer experiences Feeling safe in playground Activities and hobbies	0.385	0.294	0.505	0.000
Positive teacher-child relationship Positive peer experiences	0.392	0.298	0.516	0.000

Feeling safe in playground Safe neighbourhood				
Positive teacher-child relationship Positive peer experiences Safe neighbourhood Activities and hobbies	0.393	0.303	0.51	0.000
Good school connectedness Positive teacher-child relationship Safe neighbourhood Activities and hobbies	0.398	0.297	0.535	0.000
Good school connectedness Positive peer experiences Safe neighbourhood Activities and hobbies	0.424	0.323	0.558	0.000
Good school connectedness Positive peer experiences Feeling safe in playground Safe neighbourhood	0.445	0.344	0.575	0.000
Positive teacher-child relationship Feeling safe in playground Safe neighbourhood Activities and hobbies	0.446	0.332	0.597	0.000
Good school connectedness Positive peer experiences Feeling safe in playground Activities and hobbies	0.45	0.344	0.589	0.000
Positive peer experiences Feeling safe in playground Safe neighbourhood Activities and hobbies	0.464	0.353	0.609	0.000
Good school connectedness Feeling safe in playground Safe neighbourhood Activities and hobbies	0.482	0.355	0.654	0.000

Notes: Each combination of four PCEs is examined in its own model. Adjusted for sex at birth, ethnicity, maternal age at birth, income, education, occupational status, and number of sweeps parent was single, and ACEs.

Table 3.2.3: Risk ratio (RR) differences in gang involvement between 3 or more vs 0 PCEs for different combinations of PCEs

|	RR (0 vs 3 or more PCEs)	95% CI low	95% CI high	P-value
10 lowest RR (highest reduction)				
Low-risk peers Good school connectedness Positive teacher-child relationship Positive peer experiences	0.309	0.222	0.428	0.000
Low-risk peers Positive teacher-child relationship Positive peer experiences Feeling safe in playground	0.326	0.23	0.46	0.000
Low-risk peers Positive teacher-child relationship	0.326	0.23	0.463	0.000

Positive peer experiences Activities and hobbies				
Low-risk peers Good school connectedness Positive peer experiences Activities and hobbies	0.336	0.237	0.476	0.000
Low-risk peers Good school connectedness Positive teacher-child relationship Feeling safe in playground	0.337	0.239	0.475	0.000
Low-risk peers Good school connectedness Positive teacher-child relationship Safe neighbourhood	0.337	0.24	0.475	0.000
Low-risk peers Good school connectedness Positive teacher-child relationship Activities and hobbies	0.338	0.239	0.478	0.000
Low-risk peers Positive teacher-child relationship Positive peer experiences Safe neighbourhood	0.338	0.238	0.48	0.000
Low-risk peers Good school connectedness Positive peer experiences Feeling safe in playground	0.344	0.241	0.491	0.000
Low-risk peers Good school connectedness Positive peer experiences Safe neighbourhood	0.359	0.252	0.513	0.000
10 highest RR (lowest reduction)				
Good school connectedness Positive peer experiences Feeling safe in playground Activities and hobbies	0.516	0.381	0.7	0.000
Positive teacher-child relationship Positive peer experiences Feeling safe in playground Safe neighbourhood	0.523	0.391	0.699	0.000
Good school connectedness Positive peer experiences Feeling safe in playground Activities and hobbies	0.539	0.383	0.758	0.000
Positive teacher-child relationship Positive peer experiences Safe neighbourhood Activities and hobbies	0.553	0.407	0.753	0.000
Good school connectedness Positive teacher-child relationship Safe neighbourhood Activities and hobbies	0.561	0.395	0.798	0.001
Good school connectedness Positive peer experiences	0.567	0.417	0.772	0.000

Safe neighbourhood Activities and hobbies				
Good school connectedness Positive peer experiences Feeling safe in playground Safe neighbourhood	0.569	0.415	0.779	0.000
Positive teacher-child relationship Feeling safe in playground Safe neighbourhood Activities and hobbies	0.591	0.422	0.828	0.002
Positive peer experiences Feeling safe in playground Safe neighbourhood Activities and hobbies	0.593	0.43	0.818	0.001
Good school connectedness Feeling safe in playground Safe neighbourhood Activities and hobbies	0.623	0.445	0.873	0.006

Notes: Each combination of four PCEs is examined in its own model. Adjust for sex at birth, ethnicity, maternal age at birth, income, education, occupational status, and number of sweeps parent was single, and ACEs.

Appendix to RQ4

Figure A3.4.1. Classification by deciles of neighbourhood crime (LSOA), England
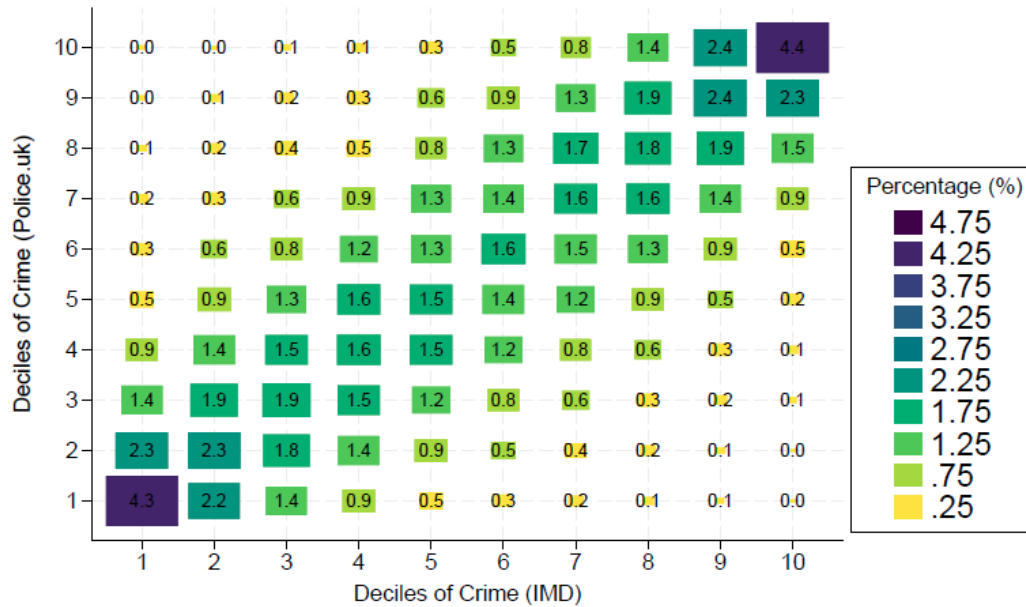
Note: Total number of LSOA in England considered in this figure is 32.670.

Figure A3.4.2. Classification by deciles of neighbourhood crime (LSOA), Wales
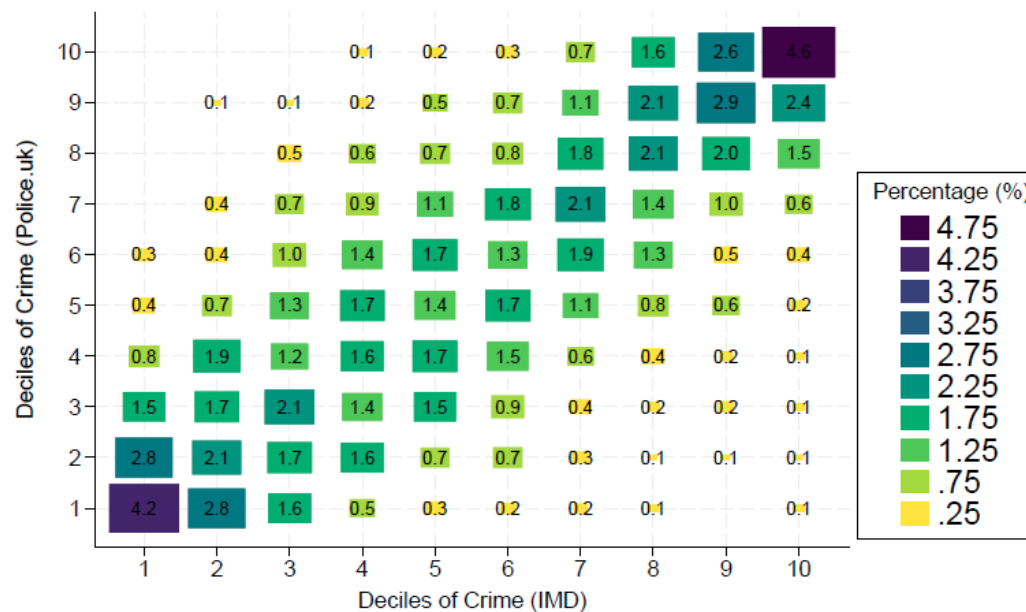
Note: Total number of LSOA in Wales considered in this figure is 1890.

Figure A3.4.3. Difference in trends in violence and sexual offences, by police force. England, North East

Figure A3.4.4. Difference in trends in violence and sexual offences, by police force. England, North West
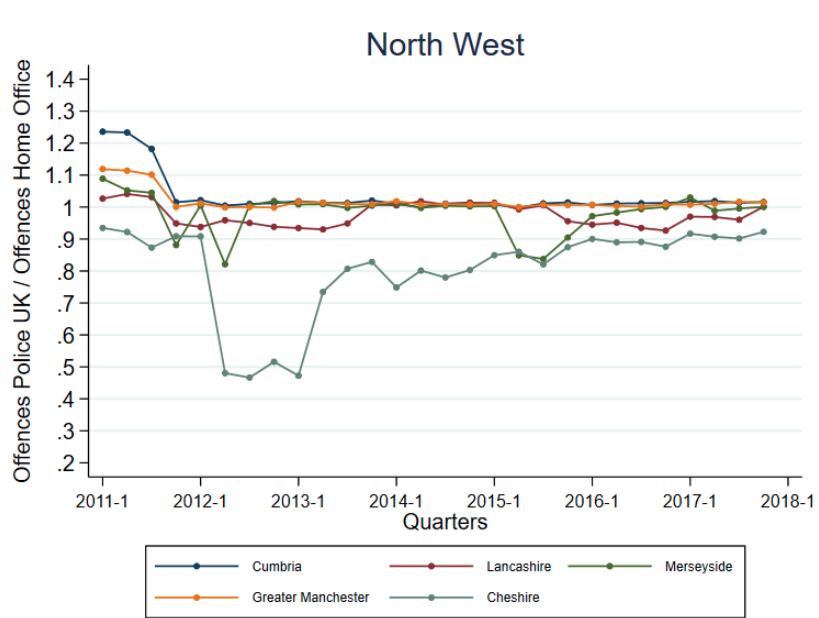
Figure A3.4.5. Difference in trends in violence and sexual offences, by police force. England, Yorkshire and The Humber
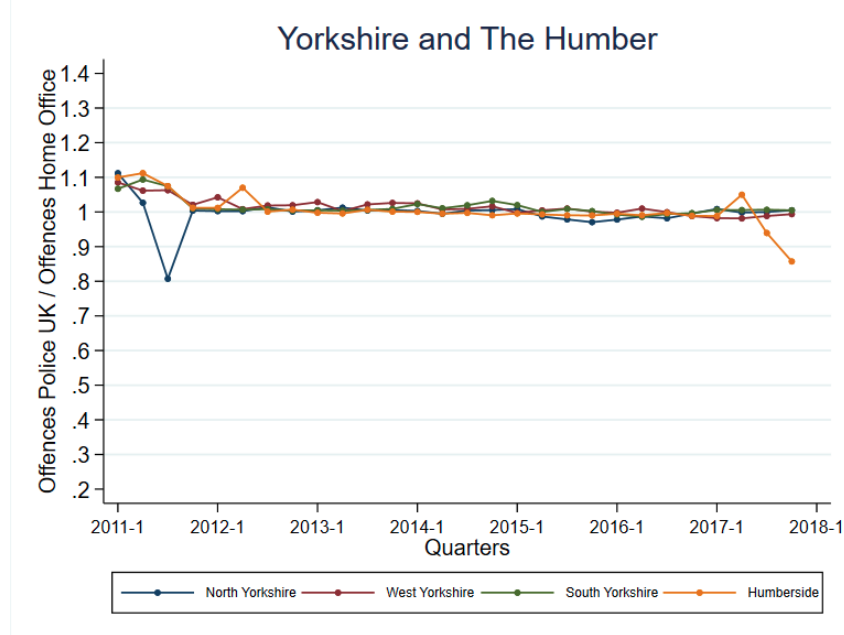
Figure A3.4.6. Difference in trends in violence and sexual offences, by police force. England, East Midlands

Figure A3.4.7. Difference in trends in violence and sexual offences, by police force. England, West Midlands

Figure A3.4.8. Difference in trends in violence and sexual offences, by police force. England, East of England
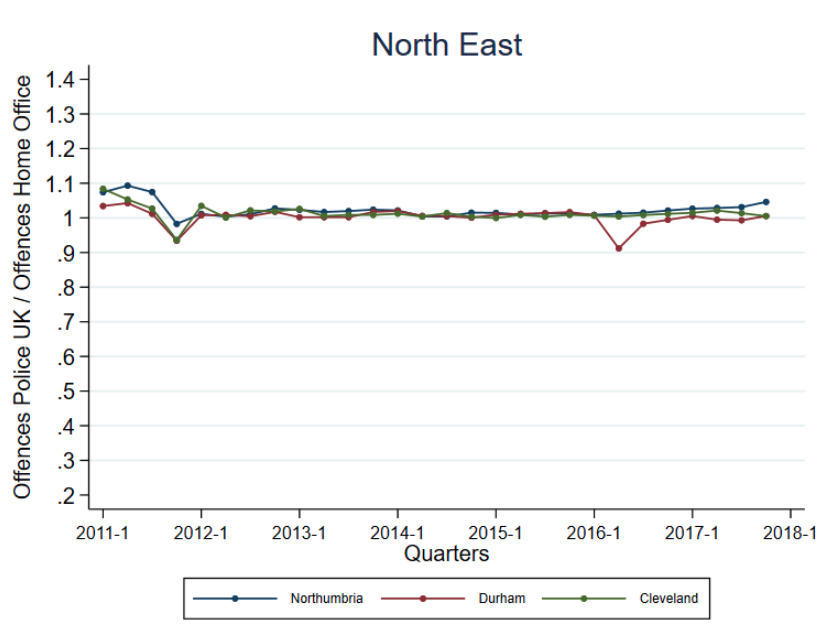
Figure A3.4.9. Difference in trends in violence and sexual offences, by police force. England, London

Figure A3.4.10. Difference in trends in violence and sexual offences, by police force. England, South East

Figure A3.4.11. Difference in trends in violence and sexual offences, by police force. England, South West
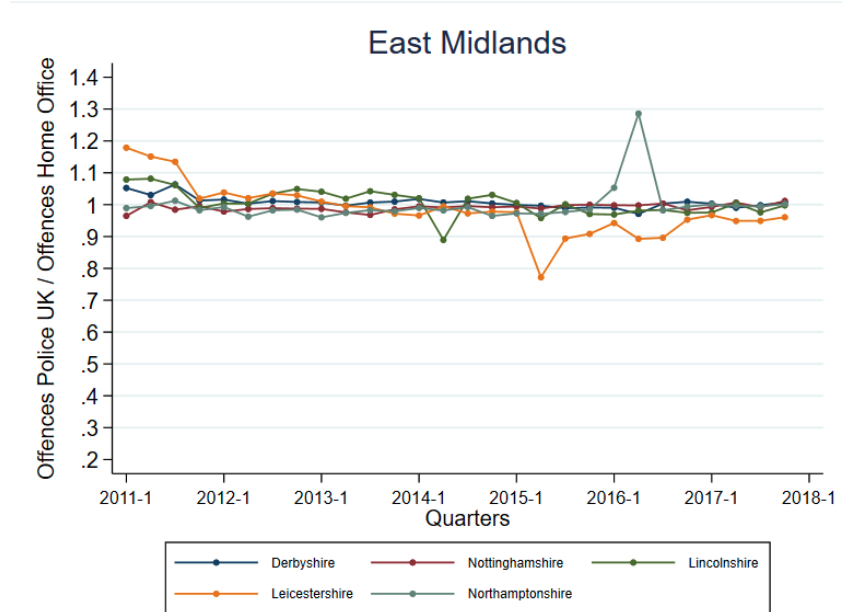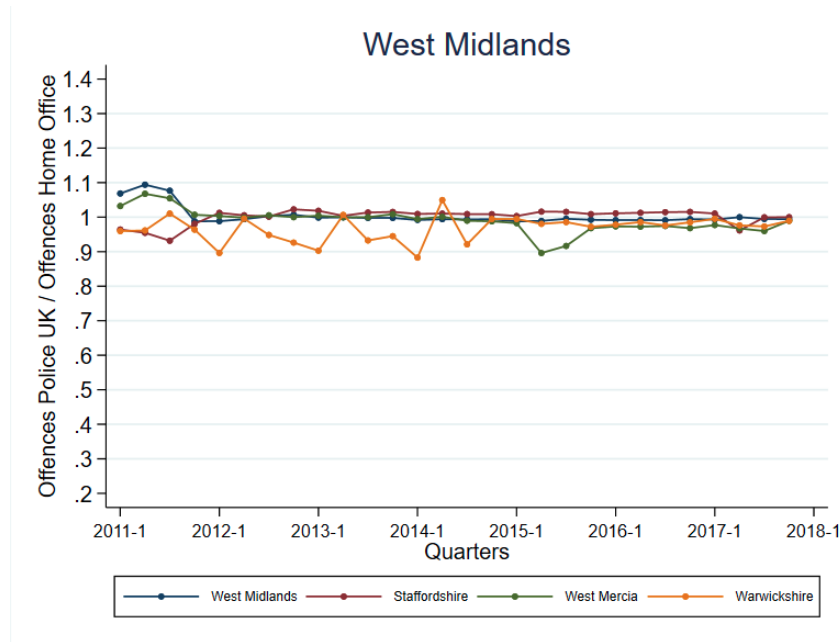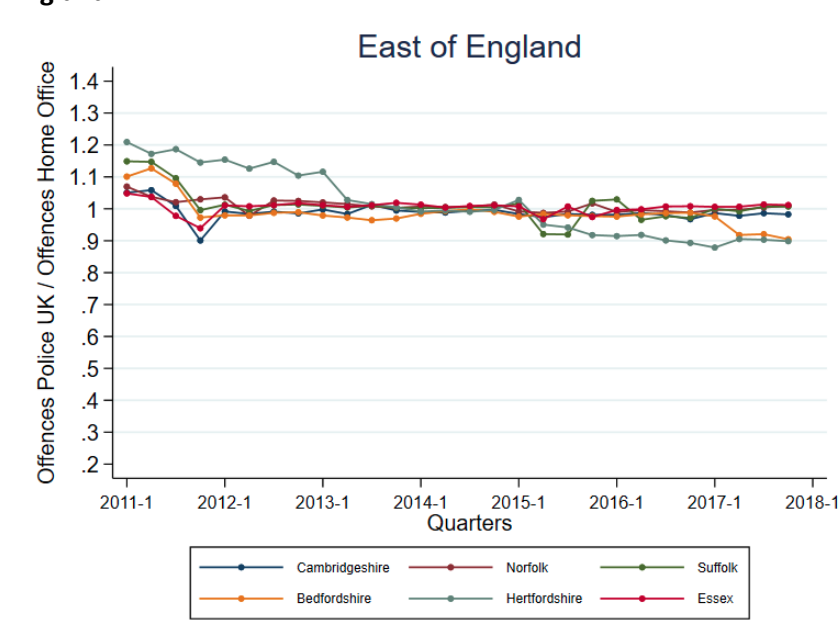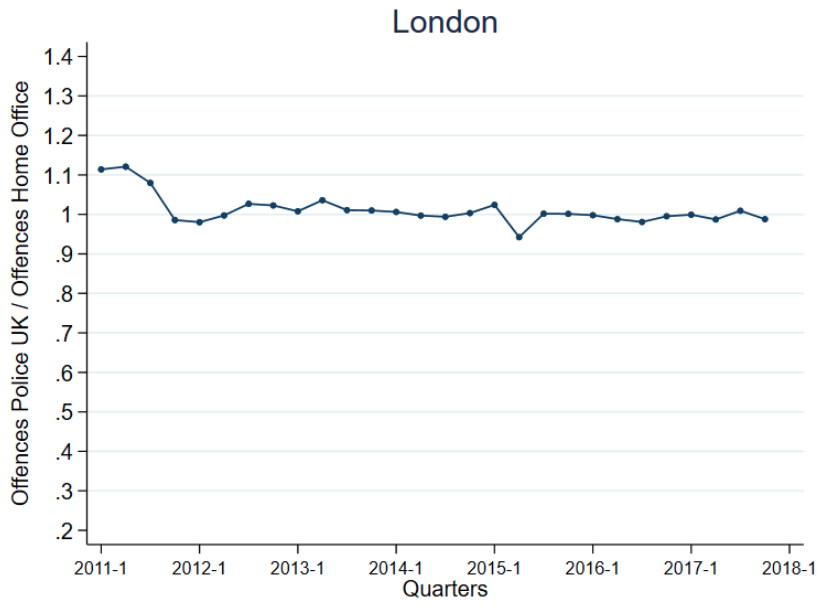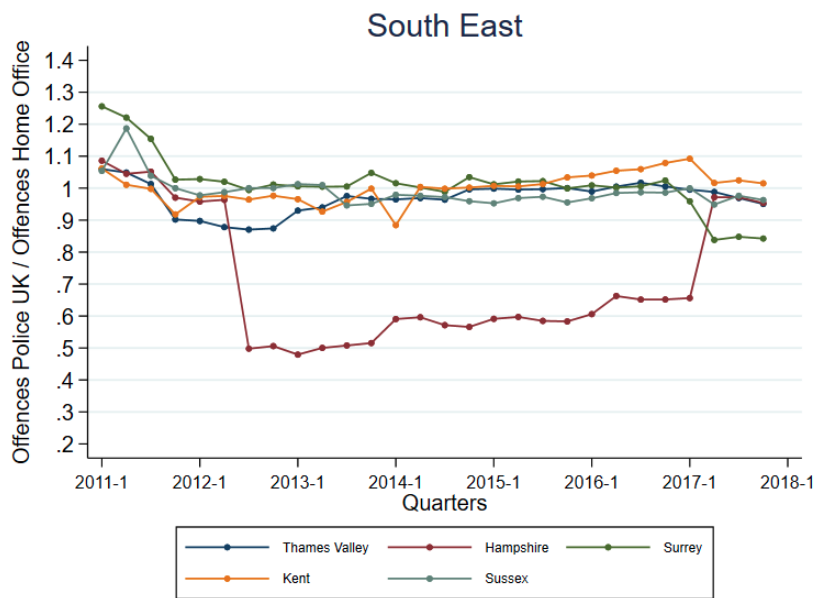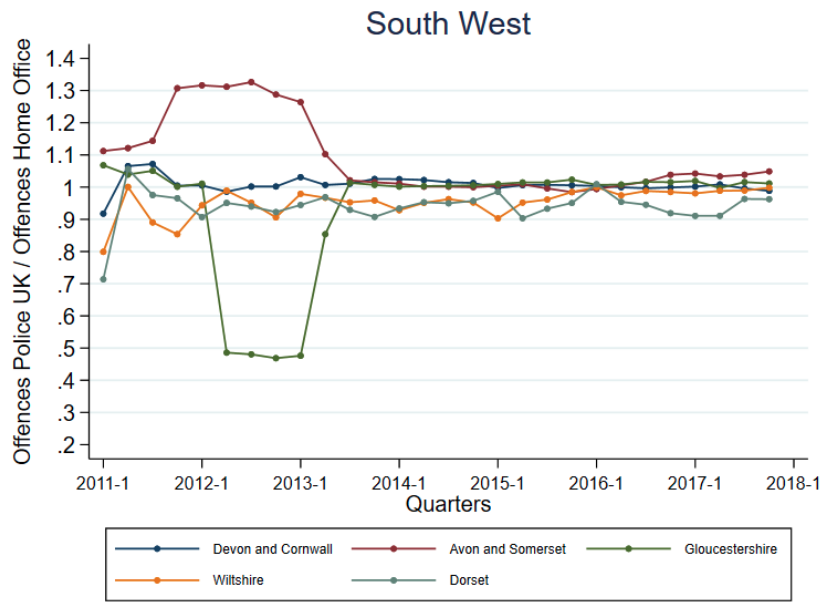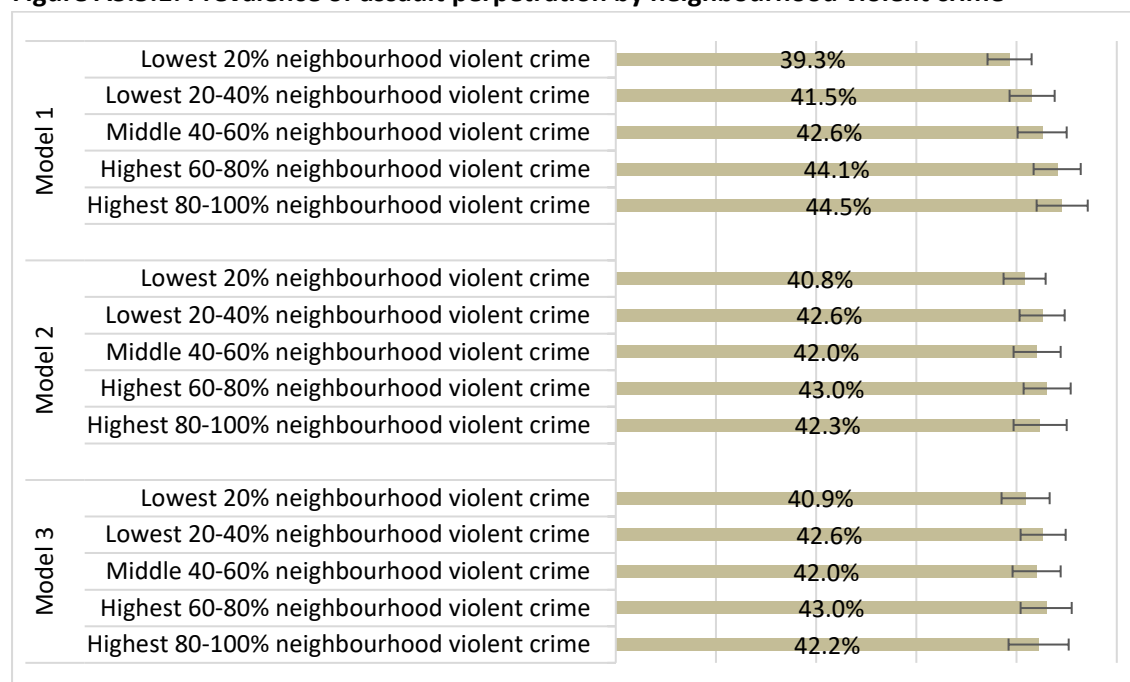
Appendix to RQ5

Figure A3.5.1: Prevalence of assault perpetration by neighbourhood violent crime

Model 1	Lowest 20% neighbourhood violent crime	39.3%
	Lowest 20-40% neighbourhood violent crime	41.5%
	Middle 40-60% neighbourhood violent crime	42.6%
	Highest 60-80% neighbourhood violent crime	44.1%
	Highest 80-100% neighbourhood violent crime	44.5%
Model 2	Lowest 20% neighbourhood violent crime	40.8%
	Lowest 20-40% neighbourhood violent crime	42.6%
	Middle 40-60% neighbourhood violent crime	42.0%
	Highest 60-80% neighbourhood violent crime	43.0%
	Highest 80-100% neighbourhood violent crime	42.3%
Model 3	Lowest 20% neighbourhood violent crime	40.9%
	Lowest 20-40% neighbourhood violent crime	42.6%
	Middle 40-60% neighbourhood violent crime	42.0%
	Highest 60-80% neighbourhood violent crime	43.0%
	Highest 80-100% neighbourhood violent crime	42.2%

Notes: Model 1: Not adjusted for any other variables Model 2: Adjusted for sex at birth, ethnicity, maternal age at birth, income, education, occupational status, and number of sweeps parent was single, ACEs and PCEs. Model 3: Adjusted for variables in model 2 and four IMD domains (income deprivation, employment deprivation, health deprivation, and education skills and training deprivation).
*** p<0.001, ** p<0.01, * p<0.05, + p<0.10

Table A3.5.1: Risk ratio differences in assault perpetration between neighbourhoods with varying levels of violent crime

	Model 1 (unadjusted)		Model 2 (adjusted)		Model 3 (adjusted)	
	Prevalence	RR	Prevalence	RR	Prevalence	RR
Lowest 20% neighbourhood violent crime	39.3%	Ref	40.8%	Ref	40.9%	Ref
Lowest 20-40% neighbourhood violent crime	41.5%	1.06	42.6%	1.04	42.6%	1.04
Middle 40-60% neighbourhood violent crime	42.6%	1.08*	42.0%	1.03	42.0%	1.03
Highest 60-80% neighbourhood violent crime	44.1%	1.12**	43.0%	1.05	43.0%	1.05
Highest 80-100% neighbourhood violent crime	44.5%	1.13**	42.3%	1.04	42.2%	1.03

Notes: Model 1: Not adjusted for any other variables. Model 2: Adjusted for sex at birth, ethnicity, maternal age at birth, income, education, occupational status, number of sweeps parent was single, and ACEs and PCEs. Model 3: Adjusted for variables in model 2 and four IMD domains (income deprivation, employment deprivation, health deprivation, and education skills and training deprivation).
*** p<0.001, ** p<0.01, * p<0.05, + p<0.10

Figure A3.5.2: Prevalence of weapon involvement by neighbourhood violent crime
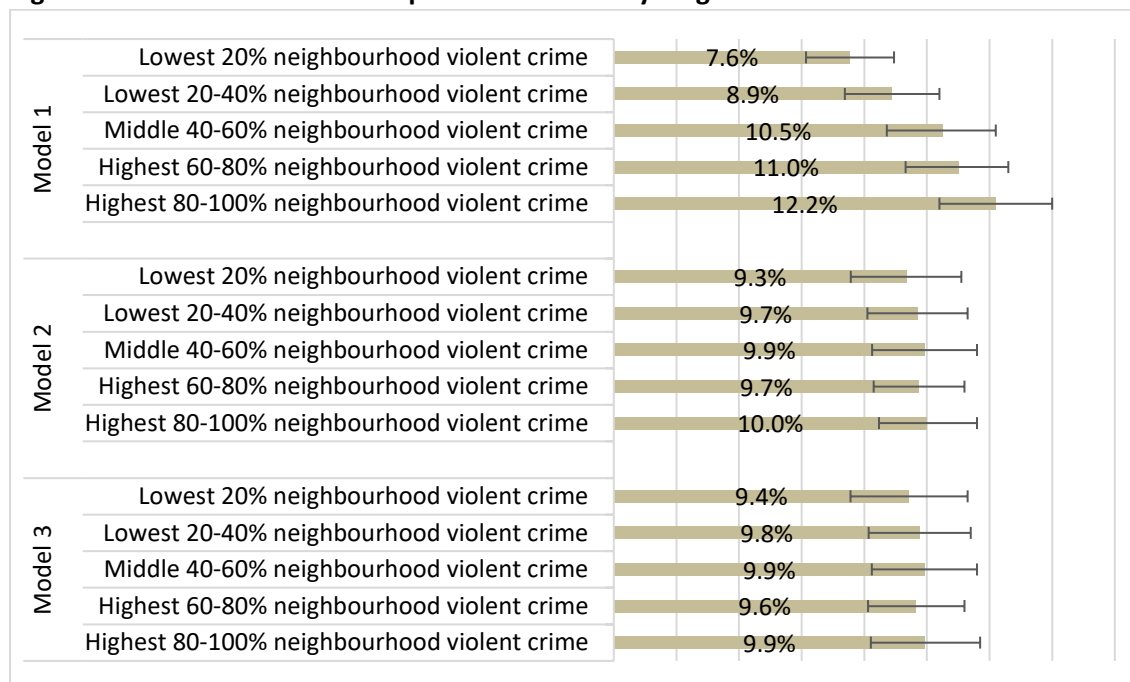

Notes: Model 1: Not adjusted for any other variables. Model 2: Adjusted for sex at birth, ethnicity, maternal age at birth, income, education, occupational status, number of sweeps parent was single, and ACEs and PCEs. Model 3: Adjusted for variables in model 2 and four IMD domains (income deprivation, employment deprivation, health deprivation, and education skills and training deprivation).
*** p<0.001, ** p<0.01, * p<0.05, + p<0.10

Table A3.5.2: Risk ratio differences in weapon involvement between neighbourhoods with varying levels of violent crime

	Model 1 (unadjusted)		Model 2 (adjusted)		Model 3 (adjusted)	
	Prevalence	RR	Prevalence	RR	Prevalence	RR
Lowest 20% neighbourhood violent crime	7.6%	Ref	9.3%	Ref	9.4%	Ref
Lowest 20-40% neighbourhood violent crime	8.9%	1.18	9.7%	1.04	9.8%	1.04
Middle 40-60% neighbourhood violent crime	10.5%	1.39**	9.9%	1.06	9.9%	1.05
Highest 60-80% neighbourhood violent crime	11.0%	1.46***	9.7%	1.04	9.6%	1.02
Highest 80-100% neighbourhood violent crime	12.2%	1.62***	10.0%	1.07	9.9%	1.05

Notes: Model 1: Not adjusted for any other variables. Model 2: Adjusted for sex at birth, ethnicity, maternal age at birth, income, education, occupational status, number of sweeps parent was single, and ACEs and PCEs. Model 3: Adjusted for variables in model 2 and four IMD domains (income deprivation, employment deprivation, health deprivation, and education skills and training deprivation).
*** p<0.001, ** p<0.01, * p<0.05, + p<0.10

Figure A3.5.3: Prevalence of gang involvement by neighbourhood violent crime
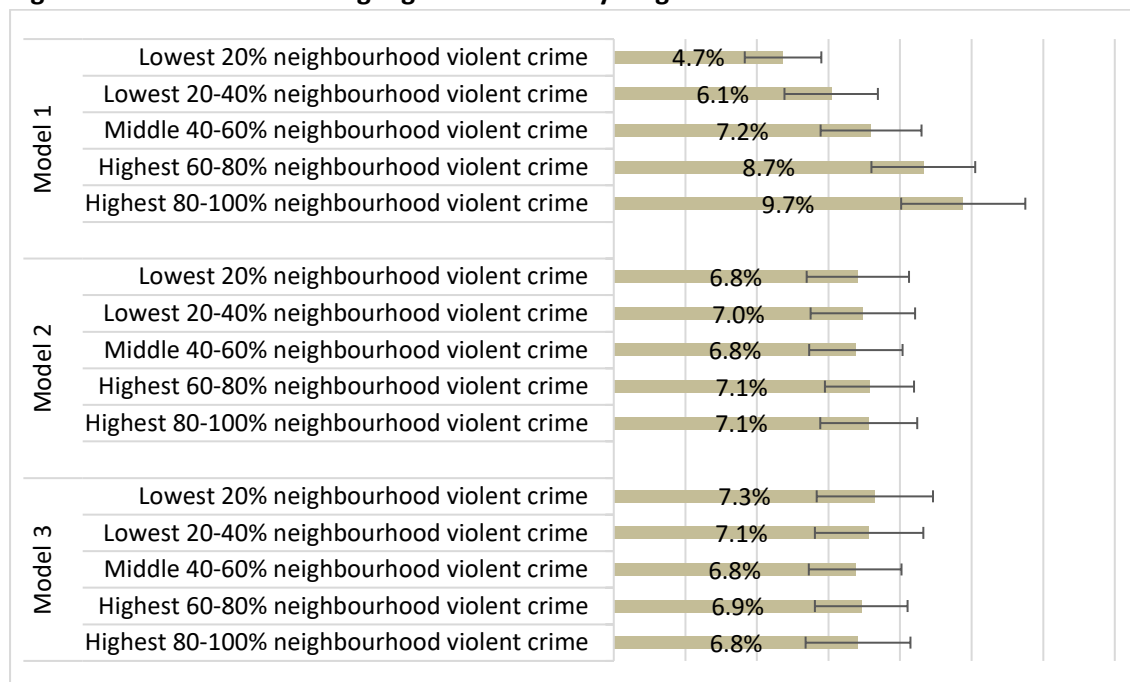

Notes: Model 1: Not adjusted for any other variables. Model 2: Adjusted for sex at birth, ethnicity, maternal age at birth, income, education, occupational status, number of sweeps parent was single, and ACEs and PCEs. Model 3: Adjusted for variables in model 2 and four IMD domains (income deprivation, employment deprivation, health deprivation, and education skills and training deprivation).
*** p<0.001, ** p<0.01, * p<0.05, + p<0.10

Table A3.5.3: Risk ratio differences in gang involvement between neighbourhoods with varying levels of violent crime

	Model 1 (unadjusted)		Model 2 (adjusted)		Model 3 (adjusted)	
	Prevalence	RR	Prevalence	RR	Prevalence	RR
Lowest 20% neighbourhood violent crime	4.7%	Ref	6.8%	Ref	7.3%	Ref
Lowest 20-40% neighbourhood violent crime	6.1%	1.29	7.0%	1.02	7.1%	0.98
Middle 40-60% neighbourhood violent crime	7.2%	1.52**	6.8%	0.99	6.8%	0.92
Highest 60-80% neighbourhood violent crime	8.7%	1.83***	7.1%	1.05	6.9%	0.95
Highest 80-100% neighbourhood violent crime	9.7%	2.06***	7.1%	1.05	6.8%	0.94

Notes: Model 1: Not adjusted for any other variables. Model 2: Adjusted for sex at birth, ethnicity, maternal age at birth, income, education, occupational status, number of sweeps parent was single, and ACEs and PCEs. Model 3: Adjusted for variables in model 2 and four IMD domains (income deprivation, employment deprivation, health deprivation, and education skills and training deprivation).
*** p<0.001, ** p<0.01, * p<0.05, + p<0.10

Figure A3.5.4: Prevalence of assault perpetration by neighbourhood general crime

Model 1
- Lowest 20% neighbourhood general crime: 39.8%
- Lowest 20-40% neighbourhood general crime: 39.9%
- Middle 40-60% neighbourhood general crime: 43.8%
- Highest 60-80% neighbourhood general crime: 44.5%
- Highest 80-100% neighbourhood general crime: 43.8%

Model 2
- Lowest 20% neighbourhood general crime: 41.3%
- Lowest 20-40% neighbourhood general crime: 40.9%
- Middle 40-60% neighbourhood general crime: 43.6%
- Highest 60-80% neighbourhood general crime: 43.1%
- Highest 80-100% neighbourhood general crime: 41.7%

Model 3
- Lowest 20% neighbourhood general crime: 41.5%
- Lowest 20-40% neighbourhood general crime: 40.9%
- Middle 40-60% neighbourhood general crime: 43.6%
- Highest 60-80% neighbourhood general crime: 43.0%
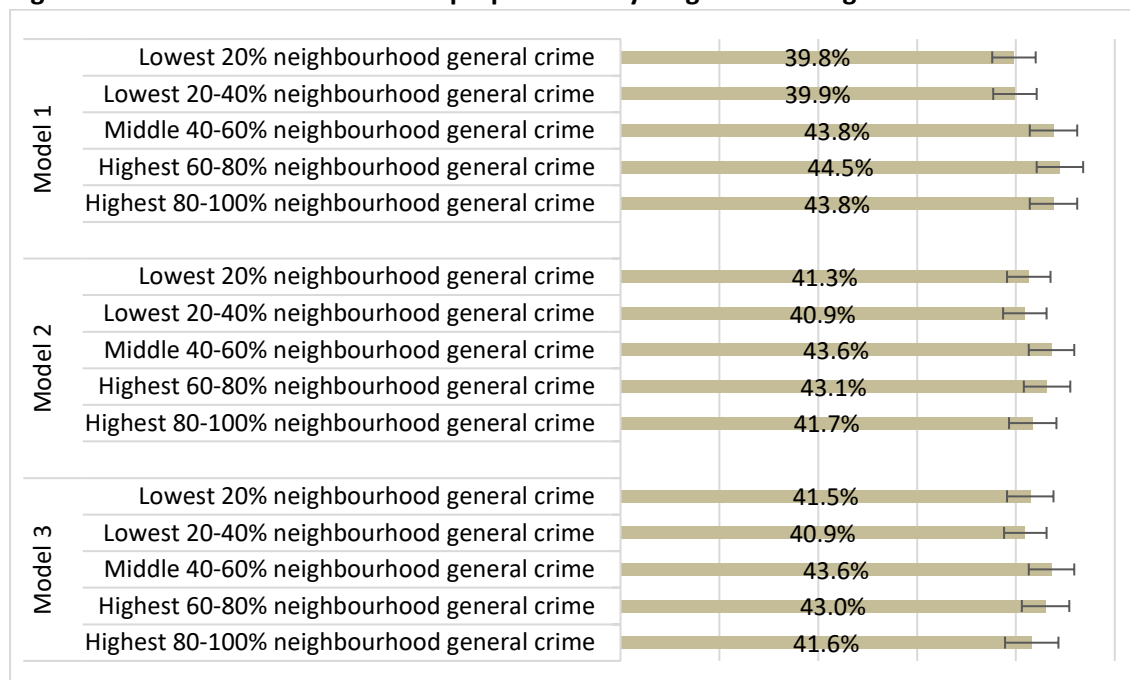- Highest 80-100% neighbourhood general crime: 41.6%

Notes: Model 1: Not adjusted for any other variables. Model 2: Adjusted for sex at birth, ethnicity, maternal age at birth, income, education, occupational status, number of sweeps parent was single, and ACEs and PCEs. Model 3: Adjusted for variables in model 2 and four IMD domains (income deprivation, employment deprivation, health deprivation, and education skills and training deprivation).
*** p<0.001, ** p<0.01, * p<0.05, + p<0.10

Table A3.5.4: Risk ratio differences in assault perpetration involvement between neighbourhoods with varying levels of general crime

	Model 1 (unadjusted)	Model 2 (adjusted)	Model 3 (adjusted)
	RR	RR	RR
Lowest 20% neighbourhood general crime	Ref	Ref	Ref
Lowest 20-40% neighbourhood general crime	1.00	0.99	0.99
Middle 40-60% neighbourhood general crime	1.10*	1.06	1.05
Highest 60-80% neighbourhood general crime	1.12**	1.04	1.04
Highest 80-100% neighbourhood general crime	1.10*	1.01	1.00

Notes: Model 1: Not adjusted for any other variables. Model 2: Adjusted for sex at birth, ethnicity, maternal age at birth, income, education, occupational status, number of sweeps parent was single, and ACEs and PCEs. Model 3: Adjusted for variables in model 2 and four IMD domains (income deprivation, employment deprivation, health deprivation, and education skills and training deprivation).
*** p<0.001, ** p<0.01, * p<0.05, + p<0.10

Figure A3.5.5: Prevalence of weapon involvement by neighbourhood general crime

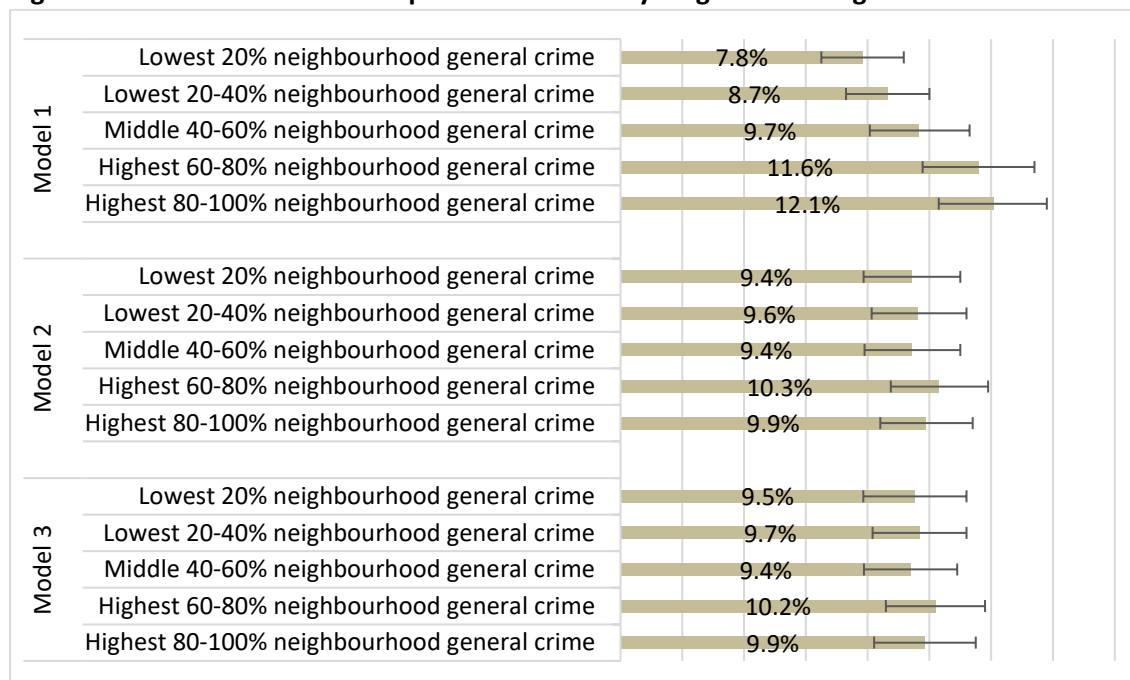|	
Model 1	
Lowest 20% neighbourhood general crime	7.8%
Lowest 20-40% neighbourhood general crime	8.7%
Middle 40-60% neighbourhood general crime	9.7%
Highest 60-80% neighbourhood general crime	11.6%
Highest 80-100% neighbourhood general crime	12.1%
Model 2	
Lowest 20% neighbourhood general crime	9.4%
Lowest 20-40% neighbourhood general crime	9.6%
Middle 40-60% neighbourhood general crime	9.4%
Highest 60-80% neighbourhood general crime	10.3%
Highest 80-100% neighbourhood general crime	9.9%
Model 3	
Lowest 20% neighbourhood general crime	9.5%
Lowest 20-40% neighbourhood general crime	9.7%
Middle 40-60% neighbourhood general crime	9.4%
Highest 60-80% neighbourhood general crime	10.2%
Highest 80-100% neighbourhood general crime	9.9%

Notes: Model 1: Not adjusted for any other variables. Model 2: Adjusted for sex at birth, ethnicity, maternal age at birth, income, education, occupational status, number of sweeps parent was single, and ACEs and PCEs. Model 3: Adjusted for variables in model 2 and four IMD domains (income deprivation, employment deprivation, health deprivation, and education skills and training deprivation).
*** p<0.001, ** p<0.01, * p<0.05, + p<0.10

Table A3.5.5: Risk ratio differences in weapon involvement between neighbourhoods with varying levels of general crime

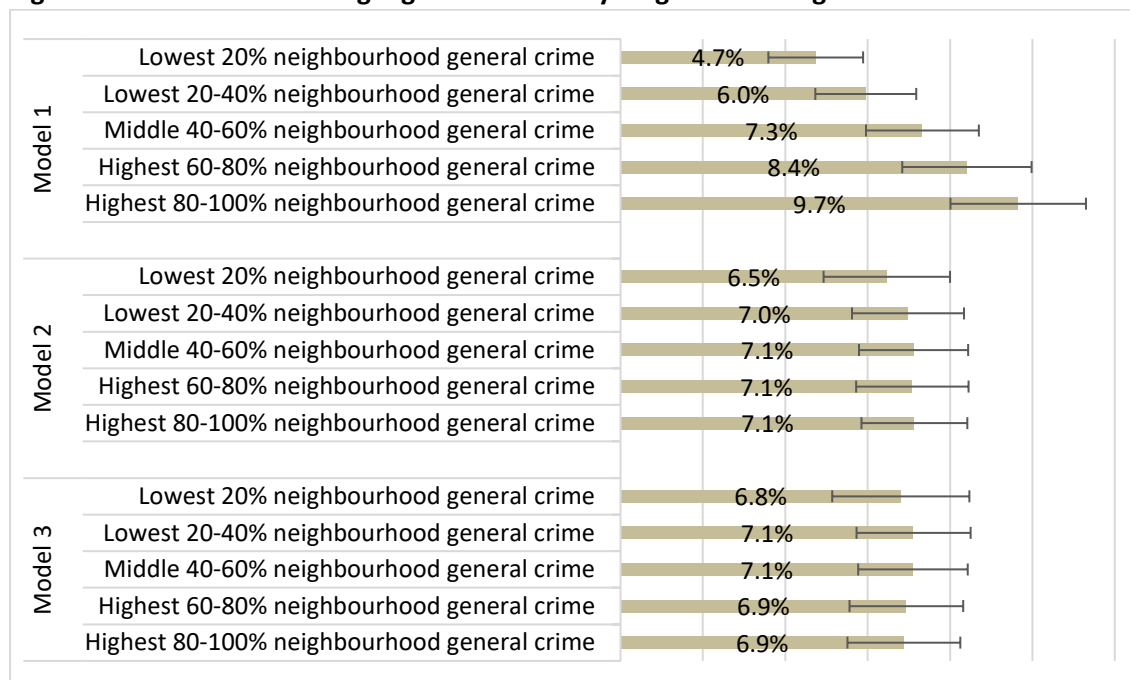|	Model 1 (unadjusted)	Model 2 (adjusted)	Model 3 (adjusted)
	RR	RR	RR
Lowest 20% neighbourhood general crime	Ref	Ref	Ref
Lowest 20-40% neighbourhood general crime	1.11	1.02	1.02
Middle 40-60% neighbourhood general crime	1.23+	1.00	0.99
Highest 60-80% neighbourhood general crime	1.48***	1.09	1.07
Highest 80-100% neighbourhood general crime	1.54***	1.05	1.03

Notes: Model 1: Not adjusted for any other variables. Model 2: Adjusted for sex at birth, ethnicity, maternal age at birth, income, education, occupational status, number of sweeps parent was single, and ACEs and PCEs. Model 3: Adjusted for variables in model 2 and four IMD domains (income deprivation, employment deprivation, health deprivation, and education skills and training deprivation).
*** p<0.001, ** p<0.01, * p<0.05, + p<0.10

Figure A3.5.6: Prevalence of gang involvement by neighbourhood general crime

		Lowest 20% neighbourhood general crime	4.7%
		Lowest 20-40% neighbourhood general crime	6.0%
Model 1		Middle 40-60% neighbourhood general crime	7.3%
		Highest 60-80% neighbourhood general crime	8.4%
		Highest 80-100% neighbourhood general crime	9.7%
		Lowest 20% neighbourhood general crime	6.5%
		Lowest 20-40% neighbourhood general crime	7.0%
Model 2		Middle 40-60% neighbourhood general crime	7.1%
		Highest 60-80% neighbourhood general crime	7.1%
		Highest 80-100% neighbourhood general crime	7.1%
		Lowest 20% neighbourhood general crime	6.8%
		Lowest 20-40% neighbourhood general crime	7.1%
Model 3		Middle 40-60% neighbourhood general crime	7.1%
		Highest 60-80% neighbourhood general crime	6.9%
		Highest 80-100% neighbourhood general crime	6.9%

Notes: Model 1: Not adjusted for any other variables. Model 2: Adjusted for sex at birth, ethnicity, maternal age at birth, income, education, occupational status, number of sweeps parent was single, and ACEs and PCEs. Model 3: Adjusted for variables in model 2 and four IMD domains (income deprivation, employment deprivation, health deprivation, and education skills and training deprivation).
*** $p<0.001$, ** $p<0.01$, * $p<0.05$, + $p<0.10$

Table A3.5.6: Risk ratio differences in gang involvement between neighbourhoods with varying levels of general crime

	Model 1 (unadjusted)	Model 2 (adjusted)	Model 3 (adjusted)
	RR	RR	RR
Lowest 20% neighbourhood general crime	Ref	Ref	Ref
Lowest 20-40% neighbourhood general crime	1.26	1.08	1.02
Middle 40-60% neighbourhood general crime	1.55**	1.10	1.02
Highest 60-80% neighbourhood general crime	1.77***	1.09	1.02
Highest 80-100% neighbourhood general crime	2.04***	1.10	1.02

Notes: Model 1: Not adjusted for any other variables. Model 2: Adjusted for sex at birth, ethnicity, maternal age at birth, income, education, occupational status, number of sweeps parent was single, and ACEs and PCEs. Model 3: Adjusted for variables in model 2 and four IMD domains (income deprivation, employment deprivation, health deprivation, and education skills and training deprivation).
*** $p<0.001$, ** $p<0.01$, * $p<0.05$, + $p<0.10$

Table A3.5.7: Examination of neighbourhood crime as continuous measures in relation to youth violence

	Assault perpetration		
	Model 1	Model 2	Model 3
	RR	RR	RR
Neighbourhood violent crime (z-scores)	1.03**	1.01	1.00
	Model 1	Model 2	Model 3
	RR	RR	RR
Neighbourhood general crime (z-scores)	1.03**	1.01	1.00
	Weapon involvement		
	Model 1	Model 2	Model 3
	RR	RR	RR
Neighbourhood violent crime (z-scores)	1.10***	1.01	1.00
	Model 1	Model 2	Model 3
	RR	RR	RR
Neighbourhood general crime (z-scores)	1.09***	1.01	1.00
	Gang involvement		
	Model 1	Model 2	Model 3
	RR	RR	RR
Neighbourhood violent drime (z-scores)	1.14***	1.01	0.99
	Model 1	Model 2	Model 3
	RR	RR	RR
Neighbourhood general crime (z-scores)	1.12***	1.01	0.99

Notes: All neighbourhood crime variables are z-scores. Model 1: Not adjusted for any other variables. Model 2: Adjusted for sex at birth, ethnicity, maternal age at birth, income, education, occupational status, number of sweeps parent was single, and ACEs and PCEs. Model 3: Adjusted for variables in model 2 and four IMD domains (income deprivation, employment deprivation, health deprivation, and education skills and training deprivation). *** $p<0.001$, ** $p<0.01$, * $p<0.05$, + $p<0.10$

Table A3.5.8: Neighbourhood violent crime association with youth violence (non-imputed data)

	Assault perpetration			
	Model 1 (unadjusted)		Model 2 (adjusted)	
	RR	95% CI	RR	95% CI
Neighbourhood violent crime				
Lowest 20% neighbourhood violent crime (ref)				
Lowest 20-40% neighbourhood violent crime	1.13*	1.01 - 1.28	1.11+	1.00 - 1.23
Middle 40-60% neighbourhood violent crime	1.15*	1.02 - 1.29	1.10+	0.99 - 1.22
Highest 60-80% neighbourhood violent crime	1.17*	1.03 - 1.31	1.09	0.97 - 1.22
Highest 80-100% neighbourhood violent crime	1.09	0.95 - 1.26	1.00	0.87 - 1.16
Observations	6,901		6,901	

	Weapon involvement			
	Model 1 (unadjusted)		Model 2 (adjusted)	
	RR	95% CI	RR	95% CI
Neighbourhood violent crime				
Lowest 20% neighbourhood violent crime (ref)				
Lowest 20-40% neighbourhood violent crime	1.16	0.78 - 1.73	1.11	0.77 - 1.60
Middle 40-60% neighbourhood violent crime	1.34	0.92 - 1.97	1.07	0.73 - 1.57
Highest 60-80% neighbourhood violent crime	1.19	0.81 - 1.77	0.90	0.61 - 1.34
Highest 80-100% neighbourhood violent crime	1.28	0.86 - 1.92	0.90	0.59 - 1.37
Observations	4,865		4,865	

	Gang involvement			
	Model 1 (unadjusted)		Model 2 (adjusted)	
	RR	95% CI	RR	95% CI
Neighbourhood violent crime				
Lowest 20% neighbourhood violent crime (ref)				
Lowest 20-40% neighbourhood violent crime	1.08	0.65 - 1.80	0.90	0.55 - 1.45
Middle 40-60% neighbourhood violent crime	1.24	0.75 - 2.07	0.76	0.45 - 1.27
Highest 60-80% neighbourhood violent crime	2.04**	1.26 - 3.29	1.05	0.66 - 1.70
Highest 80-100% neighbourhood violent crime	1.14	0.69 - 1.91	0.52*	0.30 - 0.88
Observations	4,930		4,930	

Notes: Model 1: Not adjusted for any other variables. Model 2: Adjusted for sex at birth, ethnicity, maternal age at birth, income, education, occupational status, number of sweeps parent was single, and ACEs and PCEs. *** $p<0.001$, ** $p<0.01$, * $p<0.05$, + $p<0.10$

Appendix to RQ6

Table A3.6.1: Interaction models testing neighbourhood violent crime as a moderator of the association between ACEs and youth violence

	Assault perpetration RR	Weapon involvement RR	Gang involvement RR
Model A: Binary ACEs and continuous neighbourhood violent crime			
Neighbourhood violent crime (z-scores)	1.01	1.01	1.02
ACEs			
Low ACEs (0-2) REF			
High ACEs (3 or more)	1.14***	1.43***	1.37**
ACEs x neighbourhood violent crime			
Low ACEs (0-2) x neighbourhood violent crime (REF)			
High ACEs (3 or more) x neighbourhood violent crime	1.00	1.00	0.98
Model B: Full ACEs and continuous neighbourhood violent crime			
Neighbourhood violent crime (z-scores)	1.03	1.01	1.04
ACEs			
None (REF)			
One ACE	1.09+	1.28+	1.44
Two ACEs	1.18***	1.61**	1.66*
Three ACEs	1.23***	1.81***	1.88**
Four ACEs	1.25***	1.93***	1.94*
Five or more ACEs	1.36***	2.37***	2.46***
ACEs x neighbourhood violent crime			
None x neighbourhood violent crime (REF)			
One ACE x neighbourhood violent crime	0.97	1.00	0.93
Two ACEs x neighbourhood violent crime	0.96	0.99	0.98
Three ACEs x neighbourhood violent crime	0.97	0.99	0.98
Four ACEs x neighbourhood violent crime	0.97	1.03	0.93
Five or more ACEs x neighbourhood violent crime	0.98	1.01	0.94

Notes: All models are adjusted for sex at birth, ethnicity, maternal age at birth, income, education, occupational status, number of sweeps parent was single, and PCEs. *** p<0.001, ** p<0.01, * p<0.05, + p<0.10

Appendix to RQ7

Table A3.7.1: Interaction models testing neighbourhood violent crime as a moderator of the association between PCEs and youth violence

	Assault perpetration RR	Weapon involvement RR	Gang involvement RR
Model A: binary PCEs and continuous neighbourhood violent crime			
Neighbourhood violent crime (z-scores)	1.01	1.03	1.03
PCEs			
Low PCEs (0-4) REF			
High PCEs (5+)	0.77***	0.50***	0.62***
PCEs x neighbourhood violent crime			
Low PCEs (0-4) x neighbourhood violent crime (REF)			
High PCEs (5+) x neighbourhood violent crime	0.98	0.97	0.93
Model B: Full PCEs and continuous neighbourhood violent crime			
Neighbourhood violent crime (z-scores)	1.00	1.02	0.99
PCEs			
0-2 PCEs (REF)			
3 PCEs	0.89***	0.68***	0.72**
4 PCEs	0.83***	0.53***	0.56***
5 PCEs	0.72***	0.37***	0.50***
6-7 PCEs	0.64***	0.32***	0.39***
PCEs x neighbourhood violent crime			
0-2 PCEs x neighbourhood violent crime (REF)	1.00	1.00	1.00
3 PCEs x neighbourhood violent crime	1.03	0.98	1.06
4 PCEs x neighbourhood violent crime	1.00	0.99	0.99
5 PCEs x neighbourhood violent crime	1.01	1.04	0.99
6-7 PCEs x neighbourhood violent crime	0.99	0.86	0.90

Notes: All models are adjusted for sex at birth, ethnicity, maternal age at birth, income, education, occupational status, number of sweeps parent was single, and ACEs. *** p<0.001, ** p<0.01, * p<0.05, + p<0.10