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Title: Weapon-carrying and the reduction of violent harm

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Abstract: Criminology has much to offer activities to reduce the harm of violent incidents — particularly by reducing weapon-carrying and use – but the discipline’s engagement with the harm reduction agenda has been limited. In addressing this, the paper identifies risk factors for carrying a weapon by a young person in England and Wales. It demonstrates that this decision is influenced by individual-, interpersonal- and community-level factors and that weapon carriers can be distinguished from other respondents using relatively few characteristics. The study also shows that defensive factors, such as victimisation and concerns about personal safety are relevant to understanding weapon-carrying, but they are outweighed by criminogenic factors such as violence, neighbourhood disorder and, importantly, lack of trust in the police.

Keywords: Weapons; Violence; Harm reduction; Risk factors

Introduction

Violence, weapon use and public health

Weapon use in a violent incident is strongly associated with harm (Zimring 1968; Brennan, Moore and Shephed 2006; Cook 2018) and removing weapons from violent encounters would significantly reduce the global burden of violent harm. Observations about the harm of weapons, alongside the positioning of violence as a public health issue (Dahlberg and Mercy 2009; World Health Organization 2002), has led weapon-carrying to become a shared priority for criminal justice and public health policy-makers and researchers (WHO 2002; Williams and Donnelly 2014).

Although not usually discussed in these terms, the prevention of weapon-carrying should be seen as a form of 'harm reduction'. Emerging from public health research in the 1980s, harm reduction is a philosophical and practical approach that advocates for reducing the harm of risky behaviours alongside or sometimes instead of their prevention. With the exception of research in the areas of drugs and sex work, and despite its emphasis on crime prevention, criminology has not embraced this agenda. However, three factors suggest that criminology is ready to engage with this approach with regard to violence.

Firstly, the development (Sherman *et al* 2016) and adoption of measures of criminal harm (Statistics Canada, 2009) indicates an intellectual and practical turn towards locating crimes – particularly violence – along a spectrum of harm rather than as discrete events. Secondly, the expansion of the 'law enforcement and public health' movement (van Dijk and Crofts 2016) represents a

convergence of public health and criminological approaches to violence prevention. Thirdly, while violent crime is at historically low levels, the proportion of violence involving weapons has remained constant, suggesting that weapon use is a sensible next target for violence reduction efforts. In an effort to build further momentum, this paper suggests that the harm reduction agenda should incorporate violence prevention, specifically by removing weapons from violent encounters and seeks to demonstrate that criminology can be a valuable partner to public health activity in this area. Specifically, the paper identifies risk factors for carrying a weapon by young people in England and Wales and advances theories of weapon-carrying by identifying a criminological factor in the decision to carry a weapon that has been overlooked by public health researchers – trust in the police.

Weapon and violence in England and Wales

With fewer than 10 murders per million people (Office for National Statistics 2016), England and Wales is one of the world's safest places (United Nations Office on Drugs and Crime 2013). Illegal firearm ownership and firearm-related murder is rare and knives are the most commonly-used weapons (Office for National Statistics, 2016). Despite the low base rate of murder, a 22% increase in youth homicide between March 2016 and March 2017 has led to claims that England and Wales – particularly London – is experiencing an 'epidemic of knife crime' (Jones 2017). This increase in fatalities has focused the attention of the media and politicians on the prevention of 'knife crime' and has prompted strategic responses by government (Mayor of London 2017) and police

(Metropolitan Police 2018). This increased focus on ‘knife crime’ in England and Wales and, by extension, weapon-carrying, has exposed the fact that risk factors for weapon-carrying in England and Wales have not been rigorously modelled using a national sample.

The burden of violence and weapon-carrying

The use of weapons increases the burden of violence in two ways: direct harm and contagion. Firstly, violence with a weapon tends to result in more serious injury than violence without a weapon (Brennan, Moore and Shepherd 2006; Cook 1979). In England Wales, knives were used in only 7% of all violence in 2015/16, but 37% of murders (Office for National Statistics 2017). Secondly, at a community level, weapon lethality is proportional to demand. The introduction of a new weapon type to community violence signals an increase in the overall riskiness of the area. This increases demand for more lethal weapons among those who do not have them. This contagion phenomenon has been observed in social groups (Dijkstra *et al* 2010; Tracy, Braga, and Papachristos 2016), neighbourhoods (Wilkinson and Fagan 1996) and large cities (Blumstein and Cork 1996) and, as much as the acute effects on violent harm, demonstrates why any violence prevention or harm reduction strategy must address weapon use.

Despite the disproportionate harm that weapons can cause in violence, explanations of weapon-carrying or weapon use have, in general, been limited to viewing it either as an extension of violence in general – thus, negating the need for a distinct theory of weapon-carrying – or suggesting, simplistically, that it is

a direct response to fear of victimisation (Button and Worthen 2017; Lemos 2004). Perhaps more promisingly, Dijkstra *et al* (2010) have demonstrated that weapon-carrying is the result of interaction between individual trait aggression and aggressive peer influence, while Brennan (2017) has suggested that weapon-carrying is an attempt to reduce the uncertainty of violent encounters in risky environments regardless of whether the carrier's intention is offensive, defensive, or both. Bottom-up, risk factor-driven efforts to explain weapon-carrying have yielded further insight into this behaviour by identifying who carries weapons rather than why. These studies, usually undertaken by public health researchers, have been broad in scope, but narrow in how they have hypothesised mechanisms of weapon-carrying. The present study goes beyond the limitations of these studies – summarised below – while retaining their breadth of scope by introducing a criminological risk factor – trust in the police – that advances the understanding of why young people carry weapons.

Theories of weapon-carrying: A social-ecological perspective

A common limitation of criminological research is the attempt to explain violence through a single mechanism (Sampson and Lauritsen 1994). Biological, learning, differential association, ecological and structural theories of violence all have empirical support, but none alone provide a comprehensive explanation of violent behaviour. A consequence of this is that preventive strategies that are informed by a single causal mechanism will affect fewer people than a strategy that addresses violence at individual, interpersonal, community and societal levels. For this reason, public health preventive approaches have advocated explaining

violent behaviour through a social-ecological framework (Bronfenbrenner 1979), i.e. as being influenced by interacting individual, interpersonal, community and societal factors (Dahlberg and Mercy 2009; World Health Organization 2002).

While this approach is more complex than single-levelled theories and necessitates more expansive programmes of intervention, it has a greater likelihood of affecting population-level change. In recognition of the considerable evidence that violence can be affected by mechanisms at each of these levels and seeking to inform a broad violence prevention strategy, this paper adopts a social-ecological perspective to identifying risk factors for weapon-carrying. The following overview details the existing explanations of weapon-carrying in the international literature across the levels of the social-ecological model.

Individual-level risk factors

At the centre of the social-ecological model is the individual, consisting of demographic, experiential and attitudinal risk factors.

Demographic risk factors: Males are two (McVie 2010; Hemenway *et al* 2011) to five (Molnar *et al* 2004; Tigri *et al* 2016) times more likely to report carrying a weapon than females and weapon-carrying tends to peak in mid-adolescence (Swahn *et al* 2013; Haegerich *et al* 2014; Hemenway *et al* 2011; Ilie *et al* 2016).

Studies that have directly compared ethnic groups have found that minority groups are at heightened risk of carrying a weapon compared to white respondents (Hemenway *et al* 2011; Molnar *et al* 2004; Swahn *et al* 2013). The risk associated with socioeconomic factors is unclear because household income

is rarely well-captured in self-report surveys completed by young people. Bégue, Roché and Duke (2016) used living in public housing as a proxy for deprivation/affluence and found it to be a protective factor against weapon-carrying. However, Molnar *et al* (2004) found no relationship between family socioeconomic status and weapon-carrying, nor was there a relationship between weapon-carrying and school lunch eligibility (Williams *et al* 2002), suggesting that the relationship between deprivation and weapon-carrying is not strong.

Attitudes: Analysis of non-criminogenic psychological factors has found relatively little that predicts weapon-carrying. Weapon-carrying was more likely in sensation seekers (Thurnherr *et al* 2009) and McVie (2010) found that low self-esteem was weakly associated with weapon-carrying. Criminogenic attitudes have greater explanatory power: Bégue *et al* (2016) found that pro-delinquent attitudes positively predicted weapon-carrying, although, given the theoretical link, the relationship was surprisingly weak. Importantly, that study found no link between trust in authorities and weapon-carrying, which is relevant to the discussion of trust in the police below.

Victimisation and offending: The two most fundamental explanations for why someone might carry a weapon are because they expect to be either a victim or a perpetrator of violence. Both positions have received considerable empirical scrutiny. To those familiar with the extensive literature on victim-offender overlap, treating 'victims' and 'offenders' as mutually exclusive is naïve. That issue notwithstanding, efforts to reduce weapon-carrying and use would benefit

from knowing the relative effects of offensive and defensive motives on this behaviour. Fortunately, there is a several studies have compared the relative weight of victimisation and offending on the decision to carry a weapon, albeit through proxy variables rather than direct questioning about motives. Studies have tended to compare the relative effects of recent violent victimisation and recent violent offending, judging that these variables reflect motives. Analyses that have included recent experience of both victimisation and offending have consistently shown recent offending to be a stronger predictor of weapon-carrying than victimisation (McVie, 2010; Saukkonen *et al* 2016; Kodjo, Auinger and Ryan 2003; Spano, Pridemore and Bolland 2012). However, two studies are notable for their dissent. Yun and Hwang's (2011) analysis of predictors of carrying a weapon in school found that prior victimisation far outweighed violent delinquency. However, the types of victimisation that were used to generate their violent victimisation variable ("being threatened at gun or knifepoint; being shot at; being stabbed; and being jumped", p.371) are heavily weighted towards weapon violence and more extreme than those typically used in other studies (reflected in a low mean score of 0.36 on a 0–8 scale). This also resonates with the very strong relationship between weapon-carrying and being threatened or attacked with a knife reported by Webster, Gainer, and Champion (1993; odds ratio 5.74 for males) and Khubanchandani and Price (2017; odds ratio 5.14). Therefore, it is doubtful that Yun and Hwang's study can be regarded as showing that victimisation outweighs offending in the decision to carry a weapon, but is more a reflection of a linear relationship between the severity of violent victimisation and weapon-carrying. Secondly, Spano and Bolland (2013) found

that controlling for baseline violent victimisation neutralised any statistically significant relationship between baseline violent offending and gun-carrying at one-year follow-up. However, a more complex analysis in their later paper (Spano *et al* 2012), which accommodated victim-offender overlap, reversed the findings and gave greater weight to violent offending as an explanation of weapon-carrying.

Fear of victimisation: Beyond actual experience of victimisation, weapon-carrying may be driven by the anticipation of victimisation or by concerns about safety. Carrying a weapon is a plausible, albeit simplistic response to most conceptualisations of fear of crime (Farrall, Jackson, and Gray 2009). A weapon can give confidence to the carrier, it can be used to deter violence and, theoretically, it reduces the risk of harm if an encounter becomes violent (Brennan 2017). Therefore, an association between weapon-carrying and fear of victimisation or worry about personal safety is plausible. Despite this logical connection, the supporting evidence for a relationship between fear of crime and weapon-carrying is weak. Although Hemenway *et al* (2011) found that weapon-carrying was slightly more likely among respondents who “never or rarely felt safe” (p.1000), this relationship was not statistically significant once the model controlled for other variables. Saukkonen *et al* (2016) found that a ‘sense of security’ was only predictive of carrying a gun, but not of carrying a knife or other weapon and Spano and Bolland (2013) found that fear of crime at baseline did not predict weapon-carrying one year later.

Deviant identity: Carrying a weapon, and making this known to others may be a way of shaping one's identity. Given the danger that many people associate with weapons, carrying one is an easy way to express deviant tendencies. Therefore, rather being driven by directly violent motives (offensive or defensive), weapon-carrying may simply reflect a general antisocial disposition or a desire to convey this. This has been examined in the literature in several ways. Researchers have directly measured antisocial attitudes or beliefs (Webster *et al* 1993; Bégue *et al* 2016; Williams *et al* 2002), school exclusion (Kodjo *et al* 2003), arrest (Williams *et al* 2002), general offending behaviour (McVie, 2010; Saukkonen *et al* 2016; Thurnherr *et al* 2009; Barlas and Egan, 2006) or they have employed a proxy for deviance, most commonly, substance use (McVie, 2010; Williams *et al* 2002; Khubanchandani and Price, 2017; Ilie *et al* 2017; Buschmann *et al* 2017; Thurnherr *et al* 2009). Substance use is an imperfect proxy for deviance, because behaviours associated with drug use may involve the use of a weapon, particularly if the respondent is involved in drug distribution. Nonetheless, it has value as an indicator of a more general deviance or disregard for the law. In general, these studies have identified a relationship between deviant attitudes or behaviour that is independent of violent victimisation and violent offending. While they have not yielded deeper insight than a statistical association between general deviance and weapon-carrying, Harcourt's (2006) analysis of interviews with convicted gun carriers demonstrates that weapons offer far more than a rational response to threat: they are a means through which (anti)social bonds are formed and a prop for the expression of (deviant) identity.

Trust in the police: Harcourt's (2006) insightful analysis also identified a motive for weapon-carrying that has not been explored in detail in the quantitative literature, but that may be a very important predictor of weapon-carrying: trust in police competence (Jackson and Bradford 2010). Harcourt describes how the respondents in his interviews have little faith in the ability of the police or the state to protect them from violence. This belief provides a rationale for carrying a weapon. In Harcourt's interviews, many of his respondents were engaged in drug-dealing or gang membership – occupations that offer little routine protection from police and, when disputes arise, inhibit the use of law via police to resolve the issue. These respondents are probably not typical of weapon-carriers in England and Wales, but being engaged in criminal activity is not a requirement for having reduced levels of trust in police competence (Bradford and Myhill 2014).

An alternative interpretation of 'trust in the police' is a trust in the police to execute their roles fairly. Trust in police fairness can be based on direct or vicarious experience of police discrimination, a reflection of community norms or even societal-level distrust of the police. This type of distrust could also explain weapon-carrying, but more as being endogenous of general anti-police attitudes than having a direct causal link. It is important that Bégue *et al* (2016) found no link between weapon-carrying and distrust of authorities. However, this is the only test of this relationship in the literature and a distrust of police fairness or competence may be more specific than a general distrust of authorities. Finally, it is unclear if this is a *post hoc* technique of neutralisation (Sykes and Matza

1957) or if it reflects a reasoned decision in a violent environment. Either explanation is credible. A third explanation is that a lack of trust in the police's ability to protect them is an expression of disdain for the police as an organisation rather than a realistic evaluation of threat. Indeed, the three explanations need not be mutually exclusive and any relationship between weapon-carrying and trust in police competence would require further exposition.

Interpersonal risk factors

Violence is, by definition, an interaction between two or more people. Therefore, interpersonal factors are likely to play an important role in weapon-carrying behaviour. In particular, peer influence, as a major source of information about threat and violence, should play a role. From a rational perspective, an individual may learn about the prevalence of weapon-carrying in their environment through exposure to peer weapon-carrying and respond accordingly. Alternatively, taking a differential association approach, someone may carry a weapon to reflect the behaviours of a deviant peer group.

In the US literature, the influence of both of these factors have been considered. Peer deviance was constructed in a number of ways. Firstly, respondents were often asked to describe the extent to which their peers had committed crimes or to estimate the diversity of that offending. Secondly, peer delinquency was inferred if a respondent indicated that they were a member of a gang. The effect sizes for the latter (e.g. Spano and Bolland, 2013 and Hemenway *et al* 2011,

reported odds ratios of 4.70 or greater) were typically stronger than for the former (usually up to an odds ratio of 2: McVie, 2010; Saukkonen *et al* 2016). While general peer deviance has received a lot of attention in the literature, relatively few studies have estimated the relationship between perceived peer weapon-carrying and respondent weapon-carrying. Given the contagion effects of weapon-carrying that have been demonstrated, this is an unfortunate oversight. When this relationship has been tested, it has been shown to be a very strong predictor of weapon-carrying. Williams *et al* (2002) found that having at least two of a respondent's four best friends carrying a gun in the past year was associated with an eleven-fold increase the likelihood of ever having carried a gun.

Two important studies have uncovered more about the relationship between peer and respondent weapon-carrying than simple statistical association. Firstly, Hemenway *et al* (2011) found that young people tended to overestimate the prevalence of weapon-carrying among their peers. Importantly, they also found that this effect is particularly pronounced among weapon-carriers. This miscalculation, which completes a positive feedback loop, could explain the observed contagious aspects of weapon-carrying within communities. Secondly, in a longitudinal, social network analysis, Dijkstra *et al* (2010) provided robust evidence that peer weapon-carrying may have a transformative effect on the weapon-carrying behaviour of a respondent: "participants were 2.29 times more likely to make a move towards their friends' weapon-carrying average than not to change their weapon-carrying" (p. 205). Taken together, these two findings

highlight the importance of peer behaviour on weapon-carrying and also suggest that intervening through peer influence is a potentially fruitful mechanism.

Community risk factors

If weapon-carrying is driven by perceived need for self-protection, weapon-carrying should be more likely in neighbourhoods with higher rates of weapon-carrying and violence. Similarly, if weapon-carrying is driven by violent intentions, weapon-carrying would be rational in riskier areas as an intended victim has a higher likelihood of carrying a weapon. Rennison, Jacques and Berg (2011) provided indirect support for this by demonstrating that weapon use in violence was more common against neighbourhood outsiders. Presumably this reflected assailant attempts to overcome the uncertainty of a violent encounter with a stranger who might be armed.

Studies have demonstrated that weapon-carrying and the type of weapon carried are influenced by the characteristics of the weapon carrier's neighbourhood. The most commonly-tested relationship is that between neighbourhood deprivation and weapon-carrying. Baumer *et al* (2003) showed that firearms were more likely to be used in assaults in deprived neighbourhoods than in more affluent ones. In contrast, Molnar *et al* (2004) found that neighbourhood poverty did not predict the carrying of concealed firearms in Chicago and Yun and Hwang (2011) found that neighbourhood disadvantage did not predict carrying a weapon to school.

Beyond a rational response to threat or efforts to overcome uncertainty in violent situations, a neighbourhood can have a less direct influence on weapon-carrying: Exposure to violence and weapon-carrying may inoculate a person against the seriousness of violence (Mrug, Madan and Windle 2016); weak informal social control may limit the extent to which a community can inhibit violence (Haegerich *et al* 2014); and physical signs of disorder may foster injunctive norms that violence is permissible in this area (Keizer, Lindenberg and Steg 2008). The supporting evidence for these theories varies. In a survey of high school students in Boston, Hemenway *et al* (1993) found that the more victims of violence a respondent knew, the higher their likelihood of carrying a firearm, but this relationship did not predict carrying a knife and concern about neighbourhood gun violence did not predict weapon-carrying. Spano *et al* (2012) found that exposure to community violence – experienced and witnessed – predicted weapon-carrying at one-year follow-up. However, when violent behaviour was statistically controlled, no relationship between exposure and weapon-carrying was found to exist. Both findings suggest something more complex than simple neighbourhood exposure driving weapon-carrying. More convincingly, Haegerich *et al* (2014) found a negative relationship between informal social control and weapon-carrying and Molnar *et al* (2004) found that collective efficacy – a combination of social cohesion and informal social control – was a strong protective factor against weapon-carrying. Finally, Molnar *et al* (2004) have shown that visible neighbourhood physical and social disorder are positively associated with weapon-carrying, but Haegerich *et al* (2014) found no relationship between the two.

In summary, the evidence for a link between neighbourhood and violence is moderated by the perceived level of violence rather than more tangible factors such as economic deprivation. Importantly, none of the studies that sought to test for neighbourhood effects on weapon-carrying included a robust estimate of violence or weapon use in that neighbourhood using police or health statistics. This may be a consequence of respondent-identifiable data not being available to researchers. In addition, indicators of the most useful phenomenon – prevalence of weapon-carrying – are not routinely available. This is problematic because an important confounding factor may have been overlooked in the analyses of this social-ecological level raising the risk of Type I and Type II errors and it also highlights a research and practical limitation of violence prevention – small-area estimates of weapon-carrying are extremely rare: none exist in Europe and even in the US, the illegal nature of much weapon-carrying necessitates the use of proxy estimates such as firearm suicides (Azrael, Cook and Miller 2004).

Societal risk factors

An analysis of societal risk factors for weapon-carrying requires a reliable metric of weapon-carrying at a population-level. As noted, a sufficiently granular metric does not exist for illegal weapon-carrying by young people in England and Wales (Tiratelli, Quinton and Bradford 2018). Proxy variables, such as murder and police-recorded violence involving a weapon exist in many countries and have been used to determine the impact of legislative changes in the availability of firearms on weapon violence (McPhedran 2016; Cook 2018), but the focus of

these studies on legal weapon ownership by adults limits their value for understanding illegal weapon-carrying by young people.

Hypotheses

Following a summary of the risk factors for carrying a weapon by a young person identified in an international collection of studies, this paper seeks to add to the literature by identifying risk factors for weapon-carrying by young people in England and Wales. As can be seen from the literature detailed above, the list of risk factors is long and important influencers can be found at all levels of the social-ecological model. Informed by this literature and organised around the critical masses of evidence, this paper tests the contribution of five blocks of variables to the explanation of weapon-carrying: *demographic factors*, *victimisation*, *antisocial behaviours and attitudes*, *deviant peer influence* and *neighbourhood characteristics*. As the first analysis of this behaviour with a national sample in England and Wales, the study is exploratory, resulting in a large number of hypotheses being tested. Adjustments to the threshold for statistical significance to accommodate the exploratory and multi-test nature of this study are described below.

The hypotheses on which these models are based are:

Demographics

1. Weapon-carrying is more likely among males

2. The relationship between age and weapon-carrying is non-linear with a peak in the mid-teenage years
3. Weapon-carrying is more likely in ethnic minority respondents

Victimisation

4. Weapon-carrying is more likely among those who have been threatened with violence
5. Weapon-carrying is more likely among those who have been victims of violence

Antisocial behaviours

6. Weapon-carrying is more likely among those with a history of violent offending
7. Weapon-carrying is more likely among those with a history of drug use
8. Weapon-carrying is negatively related to trust in the police

Deviant peers

9. Peers offending history is associated with an increased likelihood of carrying a weapon

Neighbourhood characteristics

10. Weapon-carrying is less likely in safer neighbourhoods
11. Weapon-carrying is more likely in disordered neighbourhoods

Methods

Sample

The OCJS is a survey of English and Welsh respondents' self-reported offending in the 12 months preceding completion of the survey. The survey began in 2003 with an initial sample of 10,079. Approximately one-third of these respondents were surveyed again each year until 2006 (inclusive). Between 2004 and 2006, the survey also added up to 2,000 new respondents. This method generated a combined panel and cross-sectional data set with a total of 25,617 completed surveys across 13,538 unique respondents. The sampling of the survey was weighted towards young people: the mean age of respondents was 23.2 years (Minimum 10 years, Maximum 66 years, Standard deviation 13.3 years) and the median age was 18 years (Interquartile range 14–25 years). The datasets for each of the four waves was downloaded from the UK Data Service archive (Home Office Research, Development and Statistics Directorate, 2008a; 2008b; 2008c).

For the purposes of this study, which focused on weapon-carrying by young people, the sample was restricted to respondents aged 25 years or younger (77% of the total sample) and, because the variable, 'trust in the police', was only introduced in 2004, the data set was restricted to years 2004-2006. Only the first completed survey from each respondent was included to avoid any potential panel effects; this resulted in a final eligible sample of 6,789 respondents. The pooling of data sets is common practice in the modelling of relatively rare events (such as weapon-carrying) and the use of multiple waves was possible due to the consistent wording of questions over waves.

Measures

Carrying a weapon. Respondents were asked if they had carried a knife or gun with them for their own protection, for use in crimes or in case they got into a fight. This was coded as a binary indicator and served as the outcome variable.

Demographic factors

Respondent *sex* was coded as a binary variable. *Age* was defined in years as a continuous variable and was centred around the mean age. An ‘age-squared’ variable was included to facilitate testing non-linearity in the relationship between age and weapon-carrying. As the distribution of *ethnicity* was heavily weighted towards white respondents, using multiple categories of ethnicity would have yielded unstable statistical models. Consequently, a binary indicator, with ‘white’ and ‘non-white’ categories was generated.

Attitudes and dispositional factors

Recent violent behaviour was captured by asking respondents if they had committed any violent offence in the last year. This was coded as a binary variable. *Drug use in the past year* was also a binary variable. *Trust in local police* was measured on a four-point Likert scale. The response options were “A lot”, “A fair amount”, “Not very much” and “Not at all”.

Personal victimisation factors

Violent victimisation was coded as a binary variable in response to the question “in the last 12 months has anyone used force against you on purpose, for example, scratched, hit or kicked you, or used a weapon of any sort, or been violent to you in any way?”. *Threat victimisation* was coded as a binary variable in response to the question “in the past 12 months, has anyone threatened you in a way that actually frightened you?”.

Interpersonal factors

Criminal peers was measured as a five-point Likert scale in response to the question: “Thinking about your closest friends. About how many of them, if any, have been in trouble with the police in the last 12 months? (not including driving fines)”. Response options were: “None of them”; “A few of them”; “Quite a lot of them”; “Nearly all of them”; and “All of them”. The distribution of this variable was highly positively skewed with fewer than 0.1% of respondents indicating that all of their friends had been in trouble with the police in the past year. To achieve a reasonable balance between item validity and model integrity, the variable was reduced to a four-point variable by merging “Nearly all of them” and “All of them” into a single category (“All or nearly all of them”).

Community factors

Perceived area disorder was created by summing binary responses to the perceived presence of six disorder-related issues in their area: noisy neighbours; teenagers hanging around causing problems; people sleeping rough on the streets or in other public places; people being harassed in the street because of

their skin colour; people using or selling drugs; and people being drunk or rowdy in public. Brunton-Smith (2011) has shown, using the OCJS data set, that these items combined can be regarded as a single latent factor, so the scores for these variables were summed to create a single continuous factor. *Perceived neighbourhood safety* was a four-point ordinal scale. Respondents were asked “how safe would you feel walking or playing alone in this area after dark?”. The response options were “very safe”, “fairly safe”, “fairly unsafe” or “very unsafe”.

Societal

As all individuals in the study lived in England and Wales, the only relevant variable at this level was *time*, which was represented by the year of the survey wave, 2004 to 2006 and treated as a categorical variable. As sentencing for weapon-related offences – particularly the carrying or use of a knife – became more severe over time and other unmeasured societal-level factors may have changed over time, it was important to include this variable.

Analytic strategy

Logistic regression was used to identify predictors of weapon-carrying. To examine the cross-validity of the results, the data were split in two with years 2004 and 2005 forming the ‘training’ (n=5,994) and 2006 forming the ‘testing’ data set (n=795). This temporally-based splitting of the data was chosen to increase confidence in the future predictive value of the models. Variables were introduced in blocks and then included in a ‘full’ model that included all

variables. A final ‘best’ model was developed using the guidelines for regression model development proposed by Gelman and Hill (2007).

As the analyses were exploratory and contained a large number of variables, a high threshold for statistical significance was set to reduce the risk of Type II (false positive) errors. The alpha-level was calculated using the Bonferroni-adjustment, which is $0.05/k$, where k is the total number of variables in the model. The ability of the models developed on the ‘training’ data set to predict weapon-carrying in the ‘testing’ data set was examined and these statistics are reported in Table 2 as area under the curve (AUC) statistics. The results section also reports confusion matrix statistics for the ‘best’ model to illustrate its ability of the model to identify weapon-carriers in the test data set.

Reproducibility: All analyses were undertaken using R statistical software version 3.4.3 (R Core Team, 2016) through RStudio version 1.1.423 (RStudio, Inc.). The following R packages were employed: ‘pscl’ (Jackman, 2017), ‘ROCR’ (Sing *et al* 2005). The R syntax used to prepare and analyse the data are available here: [github address removed temporarily – anonymised code is included as an appendix for review] and the data sets used (SN5374; SN5601 and SN6000) can be accessed through the UK Data Service: <http://www.ukdataservice.ac.uk>.

Results

Four per cent of the respondents reported carrying a weapon at least once in the 12 months preceding their completion of the survey. Table 1 is based on the pooled 2004, 2005 and 2006 data sets and presents descriptive statistics. Table 2 describes the logistic regression models and model fit statistics used in predicting weapon-carrying based on the pooled 2004 and 2005 'training' data set.

TABLE ONE ABOUT HERE

TABLE TWO ABOUT HERE

Logistic regression models

In Model 1, examining the contribution of demographic factors, males were approximately three times more likely to carry a weapon than females (H1). Age and age-squared were statistically significant predictors of weapon-carrying, which indicated that a non-linear model was a good fit for the data (H2). In this model, likelihood of weapon-carrying peaked at 17.2 years. There was no statistically significant relationship between ethnicity and weapon-carrying (H3). The model accounted for around 6% of the variance in weapon-carrying. Area under the curve (AUC) statistics indicate that ability of a model using demographics alone to accurately classify respondents was modest (AUC=0.73).

Model 2 examined the role played by antisocial attitudes and dispositional factors. Respondents who had committed a violent offence in the past year were almost four times as likely to report carrying a weapon than those who were not violent (H4). Drug use (H5) and arrested (H6) in the past year were also strong predictors of weapon-carrying. The relationship between weapon-carrying and distrust of the police was curvilinear. Respondents who had a fair amount of trust in police in their area were no more likely to carry a weapon than those who had a lot of trust in the police. Respondents who reported having not very much trust in police in their area were two and a half times and those with not trust at all were almost five times more likely to report carrying a weapon than those who had a lot of trust in the police. The model explained a reasonably proportion of the variance in weapon-carrying – 22% – but the ability of the model to correctly classify respondents was modest (AUC=0.76).

Model 3 examined the role of victimisation in predicting weapon-carrying. Having been threatened with violence (H4) and having been a victim of violence (H5) were statistically significant predictors of weapon-carrying. However, the model had a weak predictive ability (AUC=0.68) and explained only five per cent of the variance.

Model 4 examined the role of interpersonal factors on weapon-carrying and contained a single variable – delinquent peers. As the proportion of a respondent's peer had been in trouble with the police in the preceding year

increased, weapon-carrying likelihood increased rapidly. Respondents who had 'a few' friends who had been in trouble with the police were almost three and a half times as likely to have carried a weapon compared to those whose friends had not been in trouble with the police. Odds ratios for those who reported that 'quite a lot' and 'all or nearly all' of their friends had been in trouble were 11 and 8.7 times more likely to have carried a weapon, respectively. The wide confidence intervals suggest that the non-linearity observed in this relationship is more likely a reflection of the skewed distribution of peer delinquency than the actual relationship between the two variables. The model explained 14% of the variance in weapon-carrying and had modest predictive ability (AUC=0.71).

Model 5 explored the contribution of neighbourhood-level factors to weapon-carrying. In this model, the perceived extent of physical and social disorder in a respondent's neighbourhood predicted weapon-carrying, as did respondent fear of walking alone in that neighbourhood after dark. The proportion of variance explained by the model was modest and it was a modest classifier of weapon-carrying (AUC=0.68).

Model 6 - the 'full' model - contained all 14 variables. Male gender, violence and drug use, little or no trust in the police, deviant peers and area disorder were strong predictors of weapon-carrying. The model explained 33% of the variance and was a good classifier of weapon-carrying (AUC=0.87).

Model 7 describes the 'best' model. It contains nine variables. In this model, male gender, violent offending in past year, drug use in the past year, lack of trust in the police, violent victimisation and having delinquent peers were all (Bonferroni-adjusted) statistically significant predictors of weapon-carrying. The model explained 32% of the variance and was a good classifier of weapon-carrying (AUC=0.87), identifying 56% of the weapon-carriers in the testing data set (true positive=21; true negative=719; false positive=39; false negative=16).

Discussion

In summary, the risk factors for weapon-carrying among youth people in England and Wales were largely consistent with those for weapon-carrying in the international literature. Importantly, the combined characteristics of male gender, violent behaviour, drug use, little or no trust in the police, deviant peers and neighbourhood disorder identified over half of the weapon-carriers in the test data set. Although the number of weapon-carriers was relatively small, this finding indicates considerable homogeneity among weapon-carriers and holds promise for the targeting of interventions to reduce weapon-carrying among young people. In terms of explaining why young people carry weapons, this paper has demonstrated the value of a social-ecological explanation of the behaviour and has shown the contribution that criminological variables, such as trust in the police, can make to existing knowledge about the predictors of this behaviour.

Males were around two and a half times more likely to carry a weapon than females (H1); weapon-carrying was non-linearly related to age, with a peak around 17 years – slightly later than in other studies (H2). In the demographic-only model, the relationship between ethnicity and weapon-carrying was not statistically significant (H3). Because the paper set a high threshold for statistical significance and the sample had a relatively low representation of respondents from an ethnic minority, it is likely that the relationship between ethnicity and weapon-carrying is moderated by a number of external factors that needs to be explored in greater detail. Experiencing threats or violent

victimisation were strong predictors of weapon-carrying (H4, H5). However, this model explained only a small proportion of the variance when other covariates were included in the 'full' and 'best' models, none of the victimisation variables remained statistically significant. This suggests that the statistical relationship is more indicative of a victim-offender overlap than of self-defence being a direct, standalone cause of weapon-carrying. Consistent with this assertion is the observation that weapon-carrying is more strongly associated with antisocial behaviour and anti-police attitudes: violent offending (H6) and drug use (H7) in the past year and lack of trust in the police (H8) were all strong predictors of weapon-carrying. In terms of peer influence, the proportion of friends who had been in trouble with the police was a statistically significant predictor of weapon-carrying (H9), but the relationship was non-linear, with respondents who had 'quite a lot' having greater likelihood of carrying a weapon than those who reported that 'all or nearly all' of their friends had been in trouble with the police. As hypothesised, area characteristics influenced weapon-carrying. The extent of area social disorder (H10) and the extent to which a respondent regarded their area as unsafe (H11) were statistically significant predictors of weapon-carrying although the amount of variance explained by the 'Area' model was small. Area social disorder remained a statistically significant predictor in the 'full' and 'best' models, but perceived area safety did not. Finally, there was no relationship between the year of data collection and the likelihood of weapon-carrying. This suggests that national-level factors, such as macroeconomic or legislative change had little effect on the risk factors for weapon-carrying over this very short period.

Consistent with much public health and criminological research, the analysis demonstrates that offending behaviour cannot be explained by individual, interpersonal, community or societal factors alone. Each level of the social-ecological model contributes to the individual decision to carry a weapon and the picture should not be viewed through the lens of a single level. Indeed, even including variables from across the social-ecological model, the 'best' model could only explain around one-quarter of the variance in individual weapon-carrying and failed to identify almost half of the weapon-carriers in the test data set. The models are limited by what was measured in the survey and was suitable for use in the analysis. Individual-level socioeconomic and neighbourhood-level structural factors were either not available or not determinable because low-level geographic information was not available for each respondent. Nonetheless, a social-ecological approach to identifying risk factors and building predictive models offers considerable potential for understanding and responding to weapon-carrying.

The inclusion of criminological variables – particularly, trust in the police – is a step forward in the explanation of weapon-carrying behaviour. Although public health-informed models of weapon-carrying have included questions about victimisation, offending, peer influence and area safety, none to date have included all of these variables and none have included a question about trust in the police. The role of trust in the police in weapon-carrying is a valuable finding as it reveals a new mechanism through which weapon-carrying may occur.

Although young people in high-crime neighbourhoods may be 'over-policed' in terms of 'stop and search' or the prosecution of drug-related offences, they may be 'under-policed' in terms of the protection from harm or the deterrent effect that the police offer, leading to weapon-carrying as a form of self-protection.

Unfortunately, the simple language of the questionnaire item does not allow the complex dimensions of trust in the police to be unpicked. In this case, low trust in the police can mean a lack of trust in the police as an institution that has a responsibility to safeguard citizens or lack of trust that reflects police legitimacy and procedural justice. Undeniably, the two types of trust are correlated, but interventions to reduce weapon-carrying based around police legitimacy or police competence would probably look very different.

Factors relating to personal victimisation and perceived area safety predicted weapon-carrying in the more basic models but the contribution was modest when compared to the explanatory power of the variables relating to criminogenic individual-level factors such as recent offending, drug use and trust in the police and the interpersonal factor, deviant peers. Although the pseudo R-squared statistics should not be compared directly, it is difficult to dismiss the vastly superior explanatory power of the latter variables. In terms of theories of weapon-carrying, this suggests that weapon-carrying is more a reflection of a deviant or criminal lifestyle than it is a response to threat or victimisation.

However, as noted in the introduction, victim-offender dichotomies are far too simplistic: self-protection should be an important consideration for someone who plans to do violence and, someone who fears violence is probably not immune to

the desire to balance the odds of success in their own favour. One potentially fruitful way to think about weapon-carrying is as a technique for reducing the uncertainty of violent encounters (Brennan 2017). For those motivated to commit violence, weapons offer a way to overcome potential resistance, a wider pool of victims, reduced exposure to police detection and both a script (Wilkinson and Fagan 1996) and a point of focus during the 'forward panic' of violence (Collins, 2009).

The role of trust in the police in the decision to carry a weapon represents an opportunity for the typical responses of public health and criminal justice to converge. As Abt (2017) has noted, public health responses to violence tend to understate the relevance of police to directly and indirectly influence prevention. If trust in the police is a driver of weapon-carrying behaviour and violent harm, then this factor needs to be included in violence prevention strategies that originate in public health and to be embedded in interventions that span the life-course, rather than after weapon-carrying has initiated or the drivers of weapon-carrying have taken hold.

Limitations

Much has changed in the lives of young people since 2004–2006 and the risk factors for weapon-carrying may be somewhat different today. In the intervening years, social media has emerged as a major form of communication and platform for identity construction. An insult or threat to reputation can be shared far more widely and rapidly than in the past, potentially increasing the perceived

need to protect one's ego and identity in the real world (Irwin-Rogers and Pinkney 2017; Patton, Eschmann and Butler 2013). Social media's popularity-driven algorithms may distort perceptions about the threat and likelihood of serious violence through availability heuristics (Kahneman and Tversky 1973) and the effect of selective exposure to information (Wood 2017), which may affect weapon-carrying decisions.

The analysis is based on cross-sectional data. Consequently, causality and the direction of the relationship between predictors and weapon-carrying cannot be inferred. In order to first identify the variables that best identify weapon-carrying behaviour, cross-sectional analyses were required. As the OCJS contains a longitudinal subsample, in future outputs it will be possible to test the relationship between predictor variables on later weapon-carrying in order to establish a temporal direction.

Conclusion

The paper identified risk factors for carrying a weapon by young people in England and Wales. Building on the existing international literature, it has demonstrated that risk factors for weapon-carrying exist across the levels of the social-ecological model and that weapon carriers can be distinguished from other respondents using relatively few characteristics. In explaining weapon-carrying behaviour, the study showed that victimisation and concerns about personal safety are relevant, but they are outweighed by criminogenic factors such as offending behaviour, neighbourhood disorder and lack of trust in the police. The

last factor represents an important direction for future exploration and a potential avenue for intervention to reduce the harm from violence through collaboration between criminology and public health.

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Table 1. Descriptive statistics

	n	%
Weapon-carrying		
Yes	245	4.1
No	5,749	95.9
Sex		
Male	2,983	49.8
Female	3,011	50.2
Age (years)	5,994	M=16.68, SD=4.22
Ethnicity		
White	5,412	90.3
Non-white	581	9.7
Area disorder	5,994	M=1.43,SD=1.34
Area safety		
Very safe	1,111	18.6
Fairly safe	3,067	51.3
Fairly unsafe	1,241	20.7
Very unsafe	561	0.09
Violence		
Yes	999	17.19
No	4,813	82.81
Drug use		
Yes	1,163	19.85
No	4,697	81.15
Trust in the police		
A lot	1,304	22.42
A fair amount	3,161	54.35
Not very much or not at all	1,351	23.22
Victim of violence		
Yes	1,191	19.88
No	4,799	80.12
Threatened with violence		
Yes	739	12.33
No	5,253	87.77
Proportion of friends in trouble with police		
None	4,284	76.60
A few	1,309	21.6
More than a few	100	1.79

Table two. Logistic regression models

Variable (reference category)	Demographics		Antisocial		Victimisation		Deviant peers		Neighbourhood		Full model		Best model	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Sex (Female): <i>Male</i>	3.41***	2.53-4.61									2.77***	1.94-3.94	2.81***	1.99-3.95
Age	2.83***	2.03-3.94									1.41	0.96-2.08	1.42	0.97-2.09
Age squared	0.97***	0.96-0.98									0.99*	0.98-1.00	0.99*	0.98-0.99
Ethnicity (White): <i>Non-white</i>	1.43	0.97-2.11									1.54	0.96-2.46	1.54	0.97-2.46
Violence in past year (No): <i>Yes</i>			4.37***	3.28-5.83							2.79***	2.02-3.87	2.85***	2.06-3.93
Drug use in past year (No): <i>Yes</i>			2.67***	1.99-3.57							2.36***	1.67-3.32	2.41***	1.71-3.38
Trust in police (A lot): <i>A fair amount</i>			1.30	0.82-2.07							1.32	0.80-2.18	1.26	0.76-2.07
<i>Not very much or not at all</i>			2.91***	1.83-4.62							2.25**	1.35-3.78	2.27**	1.36-3.79
Victim of violence (No) <i>Yes</i>					3.22***	2.46-4.22					1.33	0.92-2.02	1.54**	1.11-2.12
Threatened with violence (No) <i>Yes</i>					1.67***	1.21-2.29					1.17	0.86-1.93		
Peers in trouble with police (None): <i>A few</i>							3.51***	2.64-4.66			1.56	1.15-2.20	1.62**	1.17-2.23
<i>More than a few</i>							8.15***	4.67-14.22			2.24	1.17-4.29	2.28*	1.20-4.35
Disorder									1.49***	1.36-1.63	1.26**	1.13-1.41	1.25***	1.12-1.39
Area safety (Very safe): <i>Fairly safe</i>									0.40***	0.30-0.55	0.62	0.43-0.90		
<i>Fairly unsafe</i>									0.33***	0.22-0.49	0.63	0.39-1.02		
<i>Very unsafe</i>									0.38***	0.24-0.62	0.91	0.49-1.66		
<i>N</i>	5,993		5,526		5,988		5,593		5,980		5,218		5,228	
McFadden's R ²	0.06		0.22		0.05		0.14		0.05		0.33		0.32	
AUC	0.73		0.80		0.66		0.71		0.68		0.88		0.87	

OR: Odds ratio; 95% CI: 95% confidence interval; AUC: Area under the curve; *p<0.05; **p<0.01; ***p<0.001