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Preventing and investigating child homicide: generating risk profiles according to victim and suspect variables

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Abstract

Purpose - In England and Wales, on average one child every week is a victim of homicide. The purpose of this paper is to explore whether different victim risk profiles and suspect variables can be differentiated for specific victim ages.

Design/methodology/approach - This paper presents a preliminary analysis of more than 1000 child homicides committed in England and Wales between 1996 and 2013, from data provided through the Homicide Index. Statistical techniques such as cluster analysis were used to identify specific victim risk profiles and to analyse suspect variables according to the age of victim.

Findings - The findings present a clearer picture of the risk-age relationship in child homicide, whereby several specific risk profiles are identified for specific child ages, comprised of crime variables including; likely victim and suspect demographics, the most likely circumstances of the homicide and methods of killing. Using similar techniques, a number of tentative clusters of suspects implicated in child homicide are also described and analysed, with suggestions of further analysis that might prove of value.

Originality and value - Although the statistical level of risk has been linked with the age of a child (with younger children being most vulnerable to killing by a parent or step-parent and older children most vulnerable to killing by acquaintances and strangers), extant research is yet to progress beyond the identification of broad age-risk categories. The paper concludes with a discussion of the likely implications for those charged with reducing and investigating child homicide and outlines the possibility of future research.

Keywords - Child homicide, victim -risk profiles, suspects, two-step cluster analysis, circumstances and relationships.

Paper type - Research study

Introduction

Homicide is the killing of a human being by another human being.[1] Not all homicide is illegal. The Criminal law in England and Wales defines unlawful homicide as comprising the crimes of murder, manslaughter (including involuntary) and infanticide, but also includes the less common causing death by dangerous or careless driving.[2] Infanticide is defined under English law in section 1 of the Infanticide Act 1938 as the killing of a child under the age of 12 months by its mother when the balance of the mother's mind was disturbed and where the death was caused by a wilful act or omission (in effect 'diminished responsibility'). Prosecutions for the crime of infanticide are rare. It is much more likely that the killing of a child under 12 months will result in a charge of murder or manslaughter. However, 'infanticide' has also taken on a wider (non-legal) meaning of the deliberate killing of very young children (see, for example, the 'Society for the Prevention of Infanticide'). There may be good criminological and statistical reasons to consider infanticide (in its more general sense) as being made of two distinct crimes: neonaticide (killing of newborn babies) and filicide (the

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[1] http://legal-dictionary.thefreedictionary.com/homicide (accessed on 25/03/2015)
[2] http://www.cps.gov.uk/legal/h_to_k/homicide_murder_and_manslaughter/#definition (accessed on 25/03/2015)

killing of babies and children older than one day) as these may exhibit quite different suspect and victim patterns (Craig, 2004).

Although many will consider murder to represent the most serious of all crimes, most will consider the murder of a child to be the most heinous crime of all (Adler and Polk, 200; Roach and Pease, 2011). Indeed if local homicide rates are thought generally to be a barometer by which personal levels of safety are calculated, as Martin Innes and colleagues term it a 'signal crime' whereby citizens interpret certain crime and disorder events as 'warning signals' about the levels of risk to which they are actually or potentially exposed (Innes, Fielding and Langan, 2002; Innes 2004; 2005; Roach, Alexander and Pease, 2012) then child homicide must be elevated to the status of 'signal, signal crime' by virtue of the fact that few crimes can provoke as much public outrage, disgust and fear. This is particularly felt when the killer is a parental figure or family member (e.g. Jason, 1983; Davies & Mouzos, 2007; Adler and Polk, 2008). Despite the devastating effect that the killing of a child has on individuals, families, and communities, compared with the amount of attention given generally to adult homicide, there is a surprising paucity of academic research related to child homicide (Roach and Shepherd, 2011). Moreover, research in this area tends to focus on the wider topic of violence and abuse directed at children per se, rather than on child killing/killers specifically. It is posited here, that a common assumption exists that child homicide is viewed by many as simply the end result of a sustained process of physical, emotional and psychological abuse at the hand of a parental figure, and that the child finally succumbs fatally to that violence. As shall be discussed, although this is unfortunately a common scenario for younger child victims, when biological fathers kill their children this instead commonly occurs as a result of a one-off 'violent event', rather than at the end of a protracted period of consistent and sustained abuse (Daly and Wilson, 1998; Adler and Polk, 2008). That said, studies have highlighted how fatal abuse is more commonly the result of the infliction of injury over a sustained period time in cases of intra-familial child homicide (Haapasalo and Petaja, 1999).

The professional use of commonly held assumptions about child homicide and the most frequent offenders, are likely to account for the misunderstandings which some claim still exist about the prevalence, identifiable trends (and their magnitude) and those most at risk of becoming victims of child homicide (Finklehor and Ormrod, 2001). Although this paper represents a modest call to rectify such an anomaly, a brief examination of the analysis of homicide in general is first presented.

The analysis of homicide

In a study of criminal homicides recorded in Philadelphia from 1948 to 1952, Wolfgang (1958) after controlling the variables of age, race and sex of both the victim and the offender tested for the effect of alcohol, the type of weapon employed, the location and time of the offence, the previous victim-offender relationship (cited in Hepburn and Voss, 1970). Wolfgang found that homicide (at least in Philadelphia) was not a homogeneous phenomenon but instead be differentiated in terms of the nature of the victim-offender relationship. The victim-offender nexus as a means of 'unpicking' the different types of homicide has been a recurring research theme in the literature (e.g. Kubrin, 2003) with most studies concluding that homicide is indeed, not homogeneous in nature but contains (albeit hidden) distinct sub-clusters. There have been many other attempts since 1958 to identify those variables or classifications that might help reveal the underlying statistical structure of homicide, including – along lines of or 'primary' versus 'non-primary' (Smith and Parker, 1980), race (Messner & Golden, 1992), gender (Browne and Williams 1995), ethnicity, and whether the homicide is 'instrumental' or 'expressive' (Salfati, 2000).

An obvious and often valuable initial approach to understanding data for the risk of child homicide is to first examine simple statistics of proportions and likelihoods. The calculation and interpretation of the proportion of victims sharing particular characteristics and the demography of offenders is common within 'Homicide Studies' (see, for example Kuhns et al., 2014). There are also a number of other statistical methods available that might help identify naturally occurring groupings or clusters in data, with 'clustering' essentially being where groups are formed so that members of the same group are similar to one another but that one group is sufficiently different to the other. In essence clustering techniques balance within-cluster homogeneity with between-cluster heterogeneity. This paper builds modestly on previous work which has identified how the risks of homicide tend to change with the age of the child (e.g. Daly and Wilson, 1985; 1988; 1998; Crittendon and Craig, 1990; Finkelhor, 1997; Boudreux, Lord and Dutra, 1999; Finklehor and Ormrod, 2000; Lawrence, 2004; Adler and Polk, 2008; Koenen and Thompson, 2008; and Mayes et al., 2010) not only by examining the data in more detail but also through applying more advanced statistical techniques. The main aim of using the more advanced techniques is to attempt identify more detailed risk clusters for specific ages, rather than simply using the frequently used large categories of *early-childhood*; *middle childhood* and *teenager (adolescent)*. By identifying age specific clusters, then rudimentary risk profiles can be developed which highlight how common variables interact, for example victim and suspect demographics, the common circumstances of the homicide and the most likely method of killing. Producing therefore, a sharper account of which factors pose the most common risks to children of different ages.

The risk of homicide and the age of the child?

The United Nations Convention on the Rights of the Child (1989: Article 1) defines a child as any individual below 18 years of age (i.e. 0 to 17 years). Child homicide therefore usually refers to those victims aged less than 18 years. There are however a string of related offences, appropriately identified by Wate and Marshall (2009)

> ➢ Child destruction
> ➢ Administering drugs and/or using instruments to procure an abortion (miscarriage)
> ➢ Unlawfully exposing and/or abandoning a child under the age of two years, where life is endangered.
> ➢ Concealing a birth.
> ➢ Neglect - death of an infant under the age of three years, caused by suffocation while the infant is in bed with person(s) who went to bed under the influence of alcohol.
> ➢ Maliciously administering poison or noxious thing so as to endanger life.

Previous research has consistently demonstrated the importance of taking a 'developmental' approach to understanding child victimisation (including child homicide and abduction) as children face different levels and types of risk at different ages (e.g. Crittenden & Craig, 1990; Finklehor, 1997; Adler and Polk, 2008; Daly and Wilson, 1988). For example, it has been reliably shown that infants under one year are at around four times the average risk of homicide (NSPCC, 2014)[3]. Indeed those aged up to one year are particularly at most risk of homicide, as they constitute the largest single age group of victims in all countries which publish homicide statistics (Lawrence, 2004; Adler and Polk, 2008; Brown & Lynch, 1995; Daly and Wilson, 1988; 1998). Children aged less than one

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[3] Found at http://www.nspcc.org.uk/globalassets/documents/information-service/factsheet-child-killings-england-wales-homicide-statistics.pdf (Accessed 25/11/2015).

year being ostensibly most at-risk due to their physiological vulnerabilities, dependence on parents and inability to escape assaults (Mayes et al., 2010). From the criminal investigator's perspective, one of the greatest challenges in child homicide, particularly with very young children, is determining the cause of death, for example where smothering often does not leave any obvious external sign of injury (Wate and Marshall, 2009) and where post-mortem findings are vague making it difficult to distinguish between homicide and Sudden Infant Death Syndrome (Sidebotham and Fleming, 2007).

The differential risks of homicide which children appear to face at different stages of childhood are best explained by the relationships that children have with others (Boudreux and Lord, 2005). Those aged less than five years, for example, have been consistently found to face an elevated risk of death at the hands of a biological or step-parental figure (Daly and Wilson, 1988; 1998; Adler and Polk, 2008; Finkelhor & Ormerod, 2001; Marks & Kumar, 1996). This is perhaps unsurprising when one considers the amount of time that young children spend with their primary care-givers. Indeed, Daly and Wilson (1998) report in their findings of a study of child homicide that young children are 100 hundred times more likely to be killed by a step-parent. The most likely cause of death of young children has consistently been found to be asphyxiation (Cavanagh, Emerson Dobash and Dobash, 2007), neglect (Silverman & Kennedy, 1988), and shaken-baby syndrome whereby the violent shaking of the child causes fatal head injuries (Stroud, 2008). The main circumstance of the killing being 'parental stress' and 'child abuse' (Cavanagh, Emerson Dobash and Dobash, 1997).

Those at the middle stage of childhood appear to be at less risk of homicide than their younger and older counterparts (Daly and Wilson, 1988: Finklehor, 1997; Adler and Polk, 2008) primarily because their 'routine activities' (Cohen and Felson, 1979) take them out of harm's way for long periods, with for example, attending school necessitating that children are away from their main care-givers for at least 6 hours a day, whereby 'parental stress' (and opportunity to harm) is reduced.

Older children (including teenagers) appear to be at higher risk of being killed by either an acquaintance or a stranger (Pritchard and Sayer, 2008), in circumstances mirroring those for adult homicide (e.g. feuds, quarrels and those involving sexual motivation).

Research has therefore consistently shown age to be the both the best predictor and explanation of who children are at most risk of being victimised by, what Finklehor (1997) refers to as *'developmental victimology'*. Boudreaux and Lord (2005:381) suggest the benefits that employing such a perspective has for those charged with preventing and investigating child homicide:

> The methodological practice of analyzing childhood crime patterns from a paediatric, age-based perspective has afforded researchers, health care professionals, law enforcement, and social service practitioners the ability to more effectively identify, investigate, and resolve serious child victimization cases.

Despite being consistently identified as an important factor both for calculating individual risk of homicide and explaining the common relationships found between children and those most likely to kill them, links between victim age and risk of child homicide remains surprisingly undeveloped. Most research on victim age and victim-suspect relationships tends to identify only broad age categories, for example Finklehor (2001) roughly differentiates between *'young children*', those in *'middle-childhood'* and' *late-childhood'* (teenagers). Whereby the main risk of homicide identified for young children are posed by family members (particularly parents and step-parents) and the main method of killing is by beating or suffocation' (Finklehor and Ormrod 2001:2). Those in middle-childhood have been consistently found to be at considerably less risk of homicide than children in the other two age categories (Daly and Wilson, 1988; 1998; Finklehor and Ormrod, 2001; Adler and

Polk 2008) but when they are killed it is still parents and family who continue to pose most risk to them. Those in late-childhood are at an increased risk of being killed by friends, acquaintances and strangers, usually by sharp instruments or kicking and beating (Finklehor and Ormrod, 2001; Roach and Shepherd, 2011). Indeed, when compared to younger children, the homicides of teenagers closely resemble those of adults (Finklehor and Ormrod, 2001).

The present study

To the writers' knowledge, there is little published statistical research that attempts to identify more specific, detailed risk profiles of homicide according to the age of the child victim, which include the circumstances of the killing, the race and ethnicity and age of suspect, and victim- suspect relationships. The present paper explores whether more detailed profiles of child homicide are identifiable according to the age of the child, by applying cluster analysis to a sample of over 1000 child homicides provided by the *UK Homicide Index.* As a parallel exploratory study we also briefly examine a possible profile of suspects involved in the homicide of children.

Method

The data

The UK Home Office *Homicide Index* (HI) lists all recorded homicides in England and Wales. The data utilised in this study initially consisted of all recorded homicides in England and Wales for the period 1st January 1993 to 31st March 2013 (inclusive) consisting of 16,602 cases across 89 different variables. As the focus of the present paper was child homicide, only those victims aged less than 18 years (0 to 17 years inclusive) were included in the analysis. It is usual for those less than 18 years of age to be considered victims of child homicide (e.g. UK[4], Australia and Canada) but for others this is not the case. In the USA for example, some states hold that males are juvenile until 21 years (when they can legally purchase liquor) and females until aged 23 years. Differences in the official age when children become adults hold obvious problems when comparing the child homicide rates for different countries.

Age of victim, however, was not the only criteria by which the initial database was restricted as unfortunately a number of significant gaps in the database were found for data between 1993 and 1995, resulting in some variables being either considered redundant (e.g. the Home Office case number), or unworkable, as they contained a vast number of 'unknown' responses. For example, more than 70% of the recording for the dichotomous variable *'lived with suspect'*, requiring a simple yes or no answer, was either 'not known' or 'not recorded'. Clearly determining whether a child lived with the suspect when killed, should pose little problem to investigators, and in most cases where the homicide is detected, we believe this information will have been accurately recorded. We hypothesise that in these instances the data on the homicide index is not made available rather than being omitted. We return to this frustration this causes researchers in the Discussion section, but suffice to say here that consequently, only a total of eight variables were selected for analysis:

1. victim age (ranging between -1 to 17)
2. victim gender (male, female)
3. victim visual ethnicity (Asian (Indian sub-continent, Black, not known/not recorded, other, White)

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[4] One notable exception is the UK Home Office and Office for National Statistics annual report on homicide for England and Wales which considers only those aged less than 17 years to be child victims. Found at http://ons.gov.uk/ons/taxonomy/index.html?nscl=Crime+in+England+and+Wales (accessed 23/02/2015).

4. method used during offence[i]
5. relationship to victim to suspect[ii]
6. main circumstance of offence[iii]
7. suspect age (ranging from 1 to 72 years of age)
8. suspect gender(male, female).

Given the gaps in the data available and the unreliability of some of the variables only those cases between 1 January 1996 and 31 March 2013 (inclusive) were analysed for the purposes of this study. Between these two dates all those cases which involved a victim up to and including 17 years were selected. There were 1935 individuals that could be classified as child homicide victims in this period. These cases fell into one of four distinct groups in terms of numbers of victims and suspects: those with exactly one victim and one suspect recorded (the great majority), those with one victim and two or more suspects, those with two or more victims and one suspect and finally, those with two or more victims and two or more suspects. Given the nature of the database utilised only those cases with one victim and one suspect could be reliably extracted (n=972).

Results

Sample descriptives

The data provided by the UK Homicide Index comprised of every recorded homicide in England and Wales from 1996 and 2013 (for all ages). From a total of 17,419 victims in this period, 13.2 % were aged less than 18 years (i.e. 0 to17 years, hereafter referred to as 'child victims') (n= 1,313). A total of 1,934 suspects were charged with committing a homicide against a child aged less than 18 years (hereafter referred to as 'suspects').

With regard to the **victims**, male children constituted 64% of victims (male= 842, female = 471) and for ethnicity, 72% (n= 948) were recorded as being white; 14% (n= 182) were black, 6% (n=83) were Asian, with the remaining 8% (n= 100) of victims recorded as either 'other ethnicity' or 'ethnicity unknown' (50 and 50). Only 15% (n= 195) of victims were recorded as having been 'living with suspect' when they were killed.

With regard to the **suspects**, 69% were male (male= 1,340, female= 459, with 4 suspects recorded as corporate/company homicides), and for ethnicity, 60% (n=1,172) were recorded as being white, 16% (n=315) as black, 7% (n=140) as Asian, with the remaining 12% (n= 237) of suspects recorded as 'other ethnicity' (n=62) or 'ethnicity unknown' (n= 175). 55 % (N= 1,067) of suspects were subsequently indicted for murder; 16% (n=317) for manslaughter, 2% (n=38) for a 'lesser offence', 1% (n=16) for infanticide, with the remaining 24% (n= 496) recorded as 'outcome unknown'. This was mostly due to the fact that many of those charged in late 2012 and 2013, were still awaiting trial at the time the data was extracted.

For the 1,221 cases where the relationship between victim and suspect was known, the most frequently occurring categories for r**elationship to victim** and the **circumstances** (of the homicide) in which they occurred, are shown in Table 1.

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Table 1. Most common categories for 'relationship to victim' and 'circumstances'

Relationship to victim (n=1,221)	Circumstances
Son/daughter (688)	Child abuse
Stranger (270)	Pub fight, neighbour feud
Step son/daughter (188)	Child abuse
Business associate (37)	Child abuse
Boyfriend/girlfriend (23)	Jealousy/possessiveness
Brother/sister (6)	Unknown
Carer/health worker/patient (5)	Child abuse
Adopted son/daughter (4)	Child abuse

As can be seen from Table 1, when all three categories relating to parenting (i.e. son/daughter, step son/daughter, and adopted son/daughter) are taken together, then the suspect was the parent in 72% (n= 880) of cases, where the relationship between victim and suspect was known/recorded.

Risk of homicide according to the age of the child

The mean age for victims was 8 years (SD =7.01 years, range 0 to 17 years) and for suspects it was 26.69 years (SD= 10.49 years, range 3 to 72 years). Homicides according to victim age are summarised in figure 1. As can be seen, the age of victims of child homicide is not evenly distributed but instead follow at U-shaped probability distribution with younger children aged 0-3 years and older children aged 14-17 years over represented as victims of homicide when compared with those aged 4-13 years.

Figure 1. Age of child victims 1996-2013
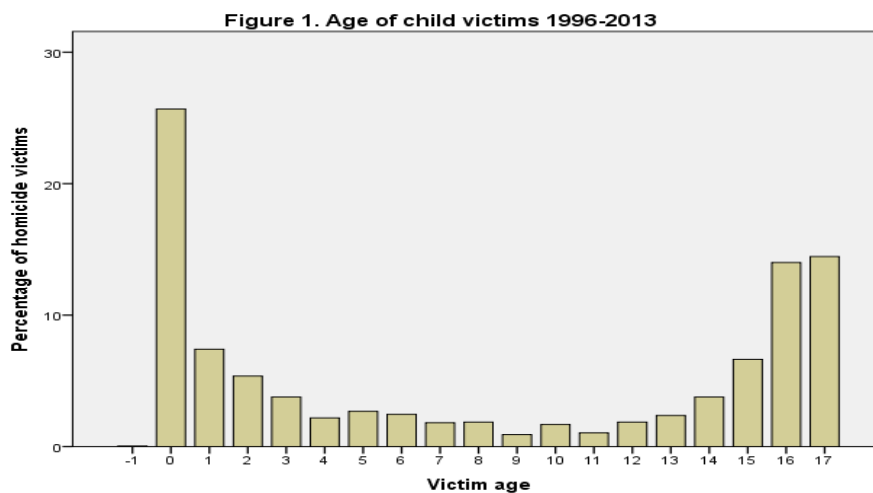
Translated into risk of homicide, young and older children appear to be at greater risk than their middle childhood counterparts, of being victims of homicide. Although previous research has identified a risk-age relationship in child homicide, as previously discussed (e.g. Daly and Wilson, 1988; Adler and Polk, 2008), this has not been explored in detail.

Cluster analysis of child homicide victims and suspects

The primary objective of cluster analysis is to group the objects (in this case child victims or suspects) in a manner that maximises the differences between clusters but at the same time minimises the variability (that is maximises the homogeneity) within a particular cluster. Although cluster analysis has been employed for some time in marketing, biology (including genetics) and medical research it has only recently been employed in homicide research. There are a number of cluster analysis methods available, including hierarchical, k-means clustering and two-step clustering and these often feature as options with statistical software such as SPSS or SAS.

Two-step cluster analysis combines hierarchical and partitioning approaches and are better suited to very large datasets that include both categorical and continuous data (Shih et al., 2010) and has the further advantage of requiring only one pass of the data. Further, two –step cluster analyses have recently been used with some success in homicide research (e.g. Liem and Reichelmann, 2014). As the name of the technique suggests, there are two main steps in forming clusters. In the first step pre-clustering is carried out by constructing a Cluster Features tree where individual cases are added (in the form of 'leaf nodes') to previous cases if the new case is sufficiently close according to a distance measure of the algorithm employed. However, if the case is sufficiently different a new pre-cluster is formed. This process effectively reduces the cases to a much smaller number of pre-clusters which are treated as essentially single objects. As the second step, the pre-clusters are hierarchically clustered together using an 'agglomerative' clustering algorithm. The 'best' number of clusters is determined by reference to either the Schwarz's Bayesian Criterion (BIC) or the Akaike Information Criterion (AIC). These criteria are derived from maximum likelihood estimates are in effect measures of the difference between the model and the actual data whilst at the same time 'rewarding' model parsimony.

The homicide index variables are of both continuous (e.g. age of victim) and categorical nature (e.g. gender of suspect) and constitute a large dataset and hence we opted for a two-step cluster analysis (Chiu et al., 2001). The degree of similarity of objects is determined using a measure of distance (e.g. the Euclidean 'as the crow flies' measurement) which is in turn is employed to cluster the data. Two-step cluster analysis employs a measure of likelihood based on distance (log-likelihood or pairwise Euclidean distance) and assumes that the cluster variables are statistically independent. Further, two-step clustering works best when any continuous variables involved follow a normal (Gaussian) distribution and when the categorical variables are multinomial in nature. In the case of the homicide index data, although the categorical variables were multinomial a number of the continuous variables (such as age of victim) were clearly not normally distributed (failing the Shapiro-Wilk test for normality). However, two-step cluster analysis is often forgiving and works reasonably well even when the assumptions have not been fully met (Garson, 2010).

Consideration was also given to using Principal Component Analysis (PCA) as an alternative method to reduce the data to a smaller number of variables that best explain the variance. PCA has been used, for example, by Bando & Lester (2014) to study the correlations between suicide, homicide and socio-economic variables in Brazil. However, in the case of the Homicide Index data PCA was found not to be suitable as a technique as the correlation between variables was found to be low and the data did not satisfy the usual requirement that the Kaiser-Meyer-Olkin Measure of Sampling Adequacy be greater than 0.6.

In order to undertake the two-step cluster analysis where necessary the data were recoded into categorical dichotomous variables. The order of data was randomised before analysis to avoid any effects which might be introduced by leaving the data in strict chronological order. Noise reduction was applied to the data.

Cluster analysis was then undertaken for victims as a group and suspects as a group. In each case the cluster models were built using a selection of the variables available from the Homicide Index. The variables were selected on the basis of an assumption (based upon the literature) concerning which of the variables were likely to be of relevance as descriptive factors for victims as a group, for suspects as a group in the circumstance of child homicide. (For example, the variable 'method used' was included in the cluster analysis for suspects, but not for victims as this variable is much more likely to coincide with a choice made by a suspect, but not a victim). The usual advice is also to avoid choosing variables for cluster analysis that are highly correlated and this also guided variable selection. The victim variables were age, ethnicity, gender, main circumstances of offence and relationship of victim to suspect. For suspects the variables selected for two-step cluster were age, gender, main circumstances of offence, method used and relationship of suspect to victim (inclusion of suspect ethnicity was found not to affect clustering).

SPSS software was used to undertake the two-step cluster analysis. SPSS has the capability of allowing the automatic selection of the optimal number of clusters (Bacher et al., 2004, p.1) Alternatively the number of clusters may be 'forced' in order to generate a reasonably small number of clusters that are similar in size but which are still inter-homogeneous but intra-heterogeneous. The latter approached was adopted for this study but only those two-step clustering solutions that met the BIC or AIC have been analysed. Not included any that were either not towards the upper end of 'fair' or in the 'good' category. Note that in some cases the BIC and AIC favoured a two cluster solution but these provided little new insights in terms of the interpretation of the underlying data. Bootstrapping was not undertaken to verify the solutions obtained but will be examined in future research.

Victim risk variable clusters

Table 2 shows the results of a two-step cluster analysis of the homicide index child homicide victim data.

Table 2. Victim profiles identified by two-step cluster analysis

VICTIMS	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Overall predictor importance
Proportion of total	28.7% (n=279)	14.5% (n= 188)	23.4% (n=227)	23.1% (n = 225)	Increase in predictor importance
Mean age of victim	1.38 years (17 months)	1.68 years (20 months)	1.88 years (23 months)	14.4 years	
Relationship of victim to suspect	Son (76%)	Son/daughter (79.9%)	Daughter (72.9%)	Friend or social acquaintance (45.3%)	
Main circumstances of offence	Child abuse (66.3%)	Child abuse (57.6%)	Child abuse (67%)	Neighbour, feud (36%)	
Gender of victim	Male (98.7%)	Female (50.0%) Male (50.0%)	Female (100%)	Male (98.7%)	
Ethnicity of victim	White (100%)	Black (36.1%) Asian (29.2%)	White (100%)	White (68.9%)	

As can be seen from Table 2, four distinct victim risk clusters are identified by analysis of the data. Each risk cluster is provisionally categorised below.

Risk cluster 1 (17 months) - *Fatal child abuse by white male parent on toddler victim.*

Risk cluster 2 (20 months) - *Fatal child abuse of black or Asian toddler by a parent*

Risk cluster 3 (23 months old) - *Fatal child abuse of female toddler by a parent*

Risk cluster 4 (14.4 years) - *Fatal attack on a high school boy by an acquaintance.*

Consideration of the implications of these victim risk clusters is saved for the Discussion section.

Suspect variable clusters

Table 3 shows the results of the two-step cluster analysis of the homicide index child homicide suspect data.

Table 3. A two-step cluster analysis of suspect variables

SUSPECTS	Cluster 1	Cluster 2	Cluster 3	Overall predictor importance
Proportion of total	43.9% (n=427)	31.2% (n= 303)	24.9% (n=242)	Increase in predictor importance
Suspect gender	Male (94.8%)	Male (95.4%)	Female (99.6%)	
Main circumstance of offence	Unknown (28.6%)	Child abuse (90.1%)	Child abuse (48.8%)	
Method used	Sharp instrument (36.3%)	Other (includes non specific methods in baby battering cases (i.e. shaking etc.) (65.7%)	Suffocation, asphyxiation or smothering (23.1%)	
Relationship of suspect to victim	Friend or social acquaintance (29.3%) [Next biggest categories, 'not known' or 'stranger']	Father (58,1%%) [Next biggest category, step father]	Mother (94.6%)	
Mean age of suspect	27.15 years	27.56 years	28.48 years	

As can be seen from Table 3, distinct suspect variable clusters are identified by analysis of the data. Each is categorised below as a child homicide scenario.

> **Suspect cluster 1** - *Male suspect in late twenties kills a friend or social acquaintance with a sharp instrument, in circumstances unknown.*

> **Suspect cluster 2** - *Male suspect in late twenties kills their own child/or step-child by battering in circumstances of child abuse.*

> **Suspect cluster 3 -** *Female suspect in late twenties kills their own child by Suffocation, asphyxiation or smothering in circumstances of child abuse.*

Particular caution is needed here as, although in terms of predictor importance the age of a suspect is the least important variable, the mean age for each clusters are similar. The values of 27.15, 27.56 and 28.48 years are not significantly different from each other. A consideration of the implications of the findings is now presented.

Discussion

Previous research of homicide data has identified differential risk of child homicide according broad categories relating to the age of the child and the most frequently occurring form of relationship between the child and his or her killer (e.g. Crittenden & Craig, 1990; Finklehor, 1997; Adler and Polk, 2008; Daly and Wilson, 1988).With very young children appearing most at risk of homicide at the hands of a parent/parental figure (e.g. Daly and Wilson, 1998: Adler and Polk, 2008).

The present research represents a tentative advance on previous research by clarifying for England and Wales, at which ages children are most vulnerable to being killed and identifies the most likely relationships they have to those most likely to kill them and further, provides some insight into how suspect groupings cluster.

In terms of the two-step cluster of victims, cluster one highlights male children aged 17 months as being most vulnerable to a parental figure in circumstances of child abuse. This has potentially considerable implications for those charged with protecting children (if supported by subsequent research), as this finding suggests that by 17 months male children who have suffered continued and sustained abuse can take no more, with a last attack seemingly fatal.

Victim cluster two highlights the vulnerability of white males aged 14 and a half years to being stabbed by a 'friend or social acquaintance' in what is categorised as a circumstance of 'neighbour feud'. Although it is not entirely possible to discern from the data what actually constitutes a neighbour feud, from what little detail is available it can be gleaned that this often occurs in situations where the killer is also male and under 18 years of age, often in a gang attack scenario (needs checking).

Victim cluster three highlights white female children of a slightly older age (23 months) to be again at most risk of being killed by a parent after sustained abuse. Again the implications for those charged with protecting children are that if this abuse is not detected and halted, the child will not survive to reach their second birthday.

Victim cluster four identifies Black and Asian children as vulnerable to killing by a parent, again after sustained abuse. The implications for those working in child protection is equally pertinent as if not stopped earlier, such sustained abuse is likely to result in the child's death before it reaches its second birthday.

In terms of two-step cluster analysis of suspects, children aged between one and less two years are at most risk of homicide t the hands of a parental figure (including step-fathers), whereby male parents will kill them by battering and mothers by suffocation/asphyxiation, in circumstances categorised as child abuse. When taken together with the victim profiles generated for younger children, then professionals charged with preventing child homicide are best advised that if abuse is not halted before the child's second birthday then a fatal violent incident is likely to occur. For those charged with investigating the homicide of a young child, if the parents are in their late twenties and the child died as a result of battering or suffocation, then they are the most probable suspects.

Suspect cluster one is arguably more surprising where boys aged between 14 and 15 years are at most risk from considerably older male friends or social acquaintances (aged in their late twenties) who kill them sharp instruments. The caveat here is that in a significant percentage of these cases, as the circumstances of the homicide are unknown, the implication of this finding for professionals is somewhat limited. All that can be said at this juncture is that without sufficient data on the circumstances in which 14 year old boys are killed, then little help can be given to prevent it.

So what are the wider implications of these findings? Although inevitably any findings must be considered tentative at this juncture, due to both the considerable amount of data omission and the ambiguity of recording categories available to police investigators, they do hold a number of possible implications for those charged with working to prevent and those with investigating child homicide.

To paraphrase the great Sherlock Holmes' comment on the necessity of good data, 'we can't make bricks without clay'[5]. Although the findings presented here go some way to enriching the detail on rudimentary child risk profiles (e.g. beyond broad age categories) these are still not detailed enough, or indeed robust enough, to be of significant use to those professionals charged with preventing and investigating child homicide. That said, knowledge of cluster profiles of victim risk and offenders, however rudimentary, will be welcome to those starting careers in child protection or criminal investigation. When one of the writers, for example, recently asked a group of child protection social workers child homicide, he was quite shocked about their lack of knowledge of patterns and risk patterns).

It appears that research of this nature, however rudimentary, holds a great practical utility for those charged with keeping children safe and those investigating the death of a child. With access to better data, research such as that presented here, then the effect could be much more impactive. The present paper ends with a call for further child homicide focussed research.

Further research

As noted earlier in this paper, there are a number of problems with conducting reliable and valid statistical research into child homicide in England and Wales caused by missing data and errors in the available data set.

A further limitation arises from the simple observation that analysis can only be undertaken with the variables that are made available and in the case of research for this paper, thee means a subset of the data collected by police that forms the national Homicide Index. Naturally, the data collected for the purposes of the Homicide Index tend to be predominantly those with a verifiable factual basis (for example, age of victim, relationship to suspect) rather than less easily defined features of child homicide, such as the interpersonal events leading up to a killing. More detailed data would also allow, for example, for the testing for the existence of meaningful clusters in the case of crimes of neonaticide and filicide (see *Introduction* above).

Although cluster analysis may result in the identification of a number of clusters which meet the criteria of statistical 'acceptability' this is no guarantee that a 'real' effect has been identified. Different cluster analysis approaches can easily give rise to different outcomes, with different assumptions taken by different methods affirming the 'unpredictable nature of the clustering process' (Gelbard et al., 2007, p. 155). More recently Latent Cluster Analysis (LCA) has been used to analyse sexual homicide (e.g. see Balemba et al., 2014). LCA employs a probability-based method for cluster modelling, as distinct from the more 'traditional' cluster analysis (such as two-step clustering) that use a distance measurement. LCA has a number of advantages which include an improved ability to handle variables with mixed measurement (e.g. ordinal and interval), and potentially may automatically produce clusters with greater practical utility. LCA might also provide a solution to the collinearity issues with the child homicide data which made cluster analysis of

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[5] (Sherlock Holmes. The adventure of the Copper Beeches).

variables which relate to both victim and suspect difficult. As a next step the authors are using LCA with homicide index data to compare the outcome for victims of child homicide and suspects with the results achieved with two-step cluster analysis.

Similarly, although a purely empirical cluster analysis may give rise to the identification of statistically valid clusters (and these clusters might even be 'named' in a way that suggests the existence of a real and recognisable situation encountered by investigators) it does not necessarily follow that the clusters have professional value. The next stage of the research will be to derive a set of clusters with a panel of homicide investigators and others with a detailed knowledge and experience of child homicide, testing the results for inter-rater reliability[6]. A suitable proportional membership algorithm could then be used to develop a cluster model that combines the statistical approach adopted in this research with the clinical results achieved through the panel.

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[6] We can only assume that the variable categories used in the Homicide Index (HI) have been verified via such a process. If not, then the effect this will have on any subsequent analysis does not bear thinking about.

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[i] Sub-categories comprise; aborting, arson, blunt instrument, burning/scalding, causing to fall against a hard surface, drowning, exhaust fumes (includes all carbon monoxide poisoning cases, i.e. car exhausts, gas fires etc.), explosion, exposure of newly-born child (killed by natural elements), hitting/kicking etc., kicking or hitting etc. without a weapon, manual strangulation, negligence or neglect, not known, other (includes non-specific methods in baby battering cases, i.e. shaking etc.), poisoning (drugs etc), sharp instrument, shooting (weapon does not necessarily need to be a firearm, e.g. crossbow, catapult), strangulation with ligature etc., struck by motor vehicle; suffocation, asphyxiation or smothering etc.

ii Sub-categories comprise; adopted son/daughter, boyfriend or girlfriend, brother or sister, business associate, carer, heath worker/patient, casual sexual partner, common-law spouse or cohabiting partner, criminal associate, Emotional rival (not elsewhere specified); Ex- spouse, ex-common-law spouse or ex-cohabiting partner; ex- boyfriend/girlfriend, friend or social acquaintance, no current suspects, other relative, prostitute/client, relationship not known, son/daughter, step-son/step-daughter, stranger.

iii Sub-categories comprise; accusations of infidelity, arising from separation, burglary, child abuse, Circumstances not elsewhere specified, neighbour/feud, pub fight/argument over girlfriend, Homicide of mother arising from abortion or similar act, Irrational act (carried out by insane or disturbed individual); jealousy/possessiveness; mercy killing; motor vehicle; other; other domestic dispute; other financial gain (not related to domestic dispute); prevent victim informing on or testifying against suspect; relating to professional activity; resulting from an offence of arson; robbery; sexual; unknown, unlawful administering of drugs).