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How can knowledge of the victim-offender relationship improve searches for disposed and concealed homicide victims in the UK?

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ABSTRACT

The location and method of disposal of a homicide victim's body can seriously affect the success of a criminal investigation. The location of a body is of particular forensic importance as both the body and the scene are essential sources of evidence and information about the victim and the perpetrator. From the perspective of the victim's loved ones, finding the body facilitates the grieving process and accelerates "closure". Indeed, without a body, the investigation is severely hampered. We propose that the relationship between the victim and offender influences the method and location of the disposal of the victim's remains.

We examined 228 solved, UK, non-serial homicides which occurred between 1920 and 2020, through an exploratory open-source search strategy, and Freedom of Information requests to police forces in England and Wales. A Chi-Square Test of Independence and a Two-Step Cluster Analysis explored relationships between the victim-offender relationship, homicide location, and body disposal location, efforts, and methods.

Our findings show that a statistically significant relationship exists between the victim-offender relationship and the homicide location, and the body disposal location. As a result, our findings make a significant contribution to existing knowledge of the factors that influence choice of location and disposal method of victims' bodies.

No database exists to capture homicides in the UK with elements of disposal, and so it was only possible to explore this project through an open-source, non-invasive research approach. Thus, our study recognises further research with UK police agencies could provide a more systematic dataset.

This is the first scientific study to compare the location and disposal method of the body with the victim-offender relationship. It could be used to inform UK police search strategies to aid the location of the victim remains, and, unlike a simple geographical profiling tool, it may even be used to predict the victim-offender relationship from the disposal method once a body is found.

1. Introduction

Homicide is one of the most serious crimes within society, creating public concern and a demand for a quick resolution [1]. Approximately 500–700 homicides occur in England and Wales per year [2]. If the remains of the victims are not found quickly, the investigation suffers, as do the bereaved [e.g., 3]. One of the reasons for a prolonged or unsuccessful search may be the effort made by the offender to deliberately conceal the remains or dispose of them in a way that hinders their discovery. A report in 2012 [3] estimated that the cost to the police of a missing persons enquiry where the person was found within 48 h was over £2,400. If the missing person is not found within 48 h, and becomes a homicide investigation, the costs quickly spiral, including hours of overtime and the use of specialised resources such as helicopters or human remains detection dogs. In 2015/16, the estimated costs of homicide investigations were £1.8billion (estimated on 580 homicides) in England and Wales. Each homicide investigation was found to cost £3,217,740. Of that, the police costs were, on average, £11,960 [4]. Delayed body recovery and identification can not only cause financial cost to police forces, but also exacerbate harm to the victim's loved ones, and can initiate wider harm to society – such as risk of further offending, or members of the public discovering a victim's remains – so a greater understanding of body disposal methods is necessary. At present, the Homicide Index and the Office for National Statistics (ONS) in England

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and Wales do not publicly identify body disposal efforts in homicide cases, so there is little publicly available information about common disposal methods in the UK.

Several factors are known to influence an offender's choice of disposal method, including inebriation or intoxication, physical characteristics, forensic awareness, and availability of resources [5]. Here, we propose that another characteristic influences the offender's disposal method, effort, and location: the victim-offender relationship (hereafter "VOR"). The VOR is currently recognised as an important aspect of the investigation process [6] yet does not typically feature in the search for homicide victims.

1.1. Disposal sites

Understanding disposal patterns is important in locating bodies, connecting offender(s) to the scene, and obtaining forensic evidence [7]. The rates of body disposal following homicides do vary, but Hakkanen and colleagues [8] suggested it was approximately one-fifth of all homicides, but this is specific to their country of analysis. There is not yet empirical evidence which provides estimates on body disposals for UK-based homicides.

There are multiple classifications of "'disposal"' in the literature. Morton et al. [9] differentiated between "dumped" and "concealed" cases. In "dumped" cases, the offender gets rid of the body with no consideration or concern for their discovery, so the body is left where and as it is. This involves the "offender mak[ing] contact with the victim within the victim's residence or taking a victim into an abandoned building, killing the victim, and afterward leaving the victim inside the same structure" [10: 12]. In "concealed" cases, the offender makes a distinct effort to delay discovery or victim identification. Concealment can include disposing of the body in water, on the ground surface, or burial.

Factors already thought to affect the body disposal method and location include practical considerations such as the physical size of victim's body [10–12], as well as situational factors such as the amount of alcohol or drugs consumed by the offender prior to the crime, or the risk of apprehension [13]. Other studies have found that the offender's body disposal method and location reflect his/her conscious choices or active decision-making, often as a result of forensic awareness [8,13–19]. However, these studies have primarily focused on body disposals of victims of serial homicides or sexually motivated killings [13,17,20–22], and so are not necessarily applicable to cases involving non-serial offences or single victims. In addition, existing research suggests that an offender's familiarity with the location, physical build, and access to a car can influence the disposal location [13].

Hakkanen et al. [8] reported that when effort was made to conceal the remains in rural disposal sites, it was often in the form of wrapping or tying the body or covering it with items found at the scene (i.e., leaves, snow, rubble etc.). Nethery's [18] sample involved almost all offenders concealing the remains through burial or covering of the body. Conversely, Burton's [24] UK study on child homicide found that only a low percentage of victims were buried. Burton [24] found that 97 percent of the victims were disposed of within 91 m of a road, demonstrating little effort made to travel with the body after death. For adult victims, the body is typically found within 15 m of a road [23].

A Canadian study highlighted that child-homicide offenders selected their disposal site before committing the crime [18]. This is a pattern mirrored in sexual homicides [25]. This is thought to be because offenders often choose a disposal site close to where they live (or have access to a property), which demonstrates familiarity with the location [8,18]. Rossmo's [19], Nethery's [18] and Hakkanen et al.'s [8] studies reported that outdoor, typically forested or water-based, locations were preferred for the disposal location for sexual homicides.

In Morton et al.'s [9] study of solved serial homicides (N = 480), the following murder sites were most prevalent in their sample: outdoor public areas (25.8%), the victim's residence (22.1%), offender's residence (18.1%), unidentified location (13.5%), and the offender's vehicles (11.5%). The disposal sites were outdoor public areas (61.5), victim's residences (20.8%), interior locations in public areas (5.8%), other living quarters (4.8%), and the offender's residence (3.8%) [9].

1.2. The victim-offender relationship (VOR)

The VOR is a well-recognised factor influencing offender decisions, and a lack of links between the victim and perpetrator pose challenges for investigators responsible for homicides (e.g. [26–28]. It has been examined in relation to the severity of victim injury in homicides and serious assaults, with contradictory results. Work by Heller et al. [29] revealed that the closer the relationship between victim and offender, the more severe the injuries, and Trojan et al. [30] found that victims of former or current intimate partners were more likely to receive injuries to the face than victims with other relationships to the offender. However, Drawdry and Myers [31] and Tamsen et al. [32] found no correlation between victim-offender relationship and number or severity of injuries.

Here, we propose that the VOR also influences the offender's disposal method, the physical effort spent on disposal, and location. Morton et al. [9] noted that the disposal efforts deployed after a homicide can assist police personnel with identification of the victim-offender relationship, which warrants further exploration. Decker [33] proposes classification of the VOR by closeness or familiarity, with the following categories suggested: "stranger", "acquaintance", "friend", "non-romantic relatives" and "romantic links". Morton et al.'s [9] examination of 480 US serial murder cases recognised the following VOR and their prevalence within the sample: customer/client relations (41.5%), strangers (31.5%), acquaintances (12.1%), targeted strangers (11.7%), and unknown (1.9%).

In terms of method and location of disposal of the victim's body, Beauregard, and Field [13] found that married offenders were more likely to move the victim's body after the homicide. Several studies have found that if the victim and offender knew each other, or were engaged in conflict [13] prior to the homicide, then the victim's body will be left at the homicide scene [34–36], but the extent of the relationship was not specified. Hakkanen et al [8] reported that offenders usually travelled no further than 50 km for body disposal, but did note that intimate partners, relatives, and strangers travel further for body disposal than acquaintances.

Chan et al.'s [37] study on "post-killing" behaviour following domestic killings in Hong Kong discovered that only 14 of 112 (13%) homicides involved the offender disposing of or hiding the victim's body. Of the 14 disposal or concealment cases, five were recorded as dismemberments. Chan et al. [37] did recognise that the degree of intimacy with the victim in intimate relationships was important for body disposal: as the relationship became more intimate (e.g., victim and offender living together for long periods of time), fewer offenders chose to dispose of the victim's body. Thus, the degree of intimacy between the victim and offender was an important indicator of disposal in Chan et al.'s [37] study, but it did not explore the methods of body disposal further. A German study found that 46% of dismemberments involved a spouse or cohabiting partner [38]. The familiarity between the offender and victim in determining the effort made by the offender to conceal or travel a distance to dispose of the victim's body has not yet been explored in the UK.

Apm et al. [39] have recently assessed the influence of the VOR, amongst other characteristics, on the distances travelled and disposal methods in homicide disposals in Queensland, Australia. They categorise offenders into 'familial', which includes current and former partners, 'acquaintances' and 'no known relationship'. Patterns were seen in the distances travelled by offenders and the disposal methods deployed, based on the relationship between the victim and the offenders. Almost half of the acquaintances (49.2%) used their vehicles to move victims from the incident site, the most common distance being 10 m.

Our study adds to the existing literature by analysing disposal patterns from solved, non-serial, UK homicides, considering how these behaviours vary depending upon the extent of the VOR. Specifically, we consider the cause of death, homicide location, the distances that the offender travels from the death to disposal location, the disposal location, method of disposal, and effort of disposal (discussed in next section), and how these factors may be influenced by the VOR.

Our main hypothesis was that the closer the relationship between the victim and the offender, the more effort the offender will go to in order to dispose of the victim's body. Our reasoning is that, in a pre-meditated homicide, an offender familiar to the victim would want to distance him/herself from the crime to avoid detection [40,41]. It may also stand to reason that an offender would try harder to make the victim's remains more difficult to discover, through concealment or distant disposal.

The aims of this study were to:

Identify patterns of body disposal in solved UK homicide cases.
Determine if there is a relationship between the victim-offender relationship and the methods used by the offender to dispose of the victim's body.
Determine if there is a relationship between the victim-offender relationship and effort made to dispose of the victim's remains.

The intention is to assist homicide investigations in one of two ways:

i. to predict disposal type and location of the body if the body has not been found but the victim-offender relationship is known, or
i. predict the victim-offender relationship from the disposal method once a body is found.

We propose that knowledge of the VOR could provide police with an indication of likely disposal sites, methods, and locations that non-serial offenders will utilise when disposing of a victim's body. This information could aid search strategies employed by law enforcement and forensic investigators, in a similar way to knowledge of a victim's last movements, such as the "Grampian Research" [42] and iFind documents [43], thereby reducing the time it takes to find victim remains, increasing the chances of a successful conviction, and decreasing investigation costs. We recommend that this information should be added to the best practice policies for search and location of victim remains in non-serial UK homicide investigations. Conversely, as Morton et al. [9] noted, when remains are found after a homicide, the disposal or concealment methods used may be helpful for investigators by aiding the prediction of the VOR and narrowing the possible list of suspects.

2. Methodology

2.1. Sample selection and data sources

The Homicide Index and the Office for National Statistics (ONS) do not make information pertaining to the disposal techniques of homicide victims in England and Wales publicly available. Thus, it was necessary to extrapolate this data using "unobtrusive measures" and open-source data [44]. Unobtrusive measures for data collection removes the need for data to be directly extracted from research subjects [45]. Online broadsheet news sites, police, and criminal justice media announcements (e.g., the Crown Prosecution Service) were the open sources used to identify applicable cases.

Homicide events are one of the most reported crimes within the media and its various platforms [see [46–50]). Innes [51] highlights that while all homicides in England and Wales are likely to receive some degree of coverage within the media, it is often confined to only local newspapers or televised news [52–54]. Thus, cases identified and used within this study required a two-stage searching process to ensure all are captured.

Firstly, the authors undertook searches through open-source materials to identify applicable cases, using the following inclusion criteria:

Each article needed to provide the victim's age, gender, relationship to offender(s), location of death and body disposal(s). The body disposal location was defined as the "final resting place" for the victim [17], before its eventual discovery, identification, and return to families.
The homicide needed to involve an element of body disposal attempt. "Disposal" was defined in this study as an action undertaken by the offender(s) to hide the victim's body (e.g., dismemberment, deposition in water, fire, burial). Conversely, "concealment" involved the offender leaving the body in situ but efforts to cover the body (e.g., wrapping the body).
The homicide was not determined to be part of a series, where the offender(s) is suspected of having killed two or more victims [55,56].
The offender(s) was convicted for the unlawful killing of the victim (i.e., murder and manslaughter convictions: [57] discusses lawful and unlawful killings within the English and Welsh legal system).

Search terms included: "body found", "disposal", "dismemberment", "human remains found", "concealed remains", and "buried body". Despite the chosen search terms producing several pages of results through the search engines, not all were relevant to the aims of this study. Cases were chosen according to the strict inclusion criteria outlined above. Both authors reviewed each case to assess and confirm their suitability for inclusion.

Secondly, the search was widened to include local newspapers which often provided further details of the victim and offender(s) than was reported in the national publications. Although most cases were initially found through the national newspapers, local papers often reported cases that did not make national news. In this stage, more specific search terms were used to identify the cases, such as the victim and offender's name and location of the incident. Local newspapers provided more specific details of the victim, and for longer periods of time, throughout the case's lifecycle (from initial recording of the homicide event to its conclusion in court). This was important for ensuring all identified variables of interest for this study were recorded.

In addition to the media searches, Freedom of Information (FOI) requests were made to all 43 English and Welsh police forces. The purpose was to ensure a comprehensive representation of applicable cases. The requests asked for the following information from 2010: the name, gender, and age of the victim and offender, and the relationship between them; the location where the homicide had taken place; the location where the body was disposed of; and the way in which the body was disposed (i.e., burial, fire, freezer etc.). The name of the victim was only requested to allow for cross referencing with online media searches, to allow further secondary research to populate all variables of interest within the study, and to avoid duplication.

A spreadsheet (Google Sheets) to collate each identified case was prepared by the authors, with the variables of interest identified before the search for cases began. The spreadsheet contained descriptive information of each case, including the victim and offender's name, age, relationship, the cause of death, motive, and details of the disposal method employed. A coding framework for the variables was established, compatible with transfer into the IBM Statistical Package for Social Sciences (SPSS, version 31). Each variable was coded as a nominal or scale variable.

Ethical approval for the research was granted by the Leeds Beckett University Research Ethics Committee.

2.2. Measures

As the study has multiple aims, the nominal variables can be divided into three distinct phases: the "*pre-homicide phase*", "*homicide phase*", and the "*post-homicide phase*". The *pre-homicide phase* includes

sociodemographic characteristics of the sample population including the victim and offender's age and gender, and the relationship between them. The *homicide phase* includes variables relating to the circumstances of the homicide, such as the location where the homicide took place. The *post-homicide phase* includes disposal methods, the location of body disposal, and the distance from the death location to disposal site. The following coding system was devised for the dependent and independent variables.

2.2.1. Dependent variables (DV)

This study has seven DVs, all of which are nominal, including variables from the *homicide phase* and the *post-homicide phase*. Coding for the location of death and the disposal site include: the shared home of the victim and offender, the victim's properties, offender's properties, rural (e.g., woodland, fields, parks), urban (e.g., construction site, industrial estate, golf course, public house), water (e.g., canal, river, sea, ditch), vehicles, and unknown.

The method of disposal of the body was coded, using categories slightly altered from Schneikert's (1939) grading of disposal methods, with this study incorporating six stages of disposal rather than Schneikert's three. The coding definitions were: leaving the body where it was (score of 1); hiding the body (eg: under leaves, under clothes, with bin bags, under snow etc, score of 2); concealing the body within a structure of some kind (eg: suitcase, shed, attic, bed, freezer etc, score of 3); disposal through use of fire, or water (4); burial (5), or dismemberment (6); and unknown/unconfirmed disposal method (7).

A scaled (1–10) coding system was created by the authors and used to code for the amount of effort made by the offender(s) to dispose of the victim's remains. This is a subjective scoring system, based on the authors' perception of physical effort required to carry out the disposal method chosen after the murder had taken place, akin to the Borg rating of perceived exertion [58]. It was deemed that travelling with the body in a car, or using fire or water to dispose of remains was physically easier than burial or dismemberment, which require exertion that raises heart rate, causes sweating and fatigue; but that burial in a shallow grave was physically easier than burial in a deep grave [59]. The more different disposal methods were used in combination, the higher the perceived physical effort and the higher the score given.

Leaving the body where it was required the least physical effort, and so was given a score of (1). When a little more effort was expended, such as an attempt was made to cover the body with easily available materials (e.g. snow, leaves, twigs), or the offender travelled with the body to dump it but no other disposal efforts were made, a score of (2) was given.

A score of (3) was given when the offender wrapped the victim's body, in items like bedding, tarpaulin, but there is no travel for disposal, and no use of fire/water; (4) the offender travels short distances to dispose of the body, and then uses either fire or water with concealing of the victim's body, like in a suitcase or car boot; (5) the victim is buried in a shallow grave, but the offender does not travel and so the victim is likely buried in the garden or nearby land; (6) the victim is buried deep, and the offender may travel a short distance for the burial; (7) the offender dismembered the victim but does not travel to dispose of the remains; (8) the offender dismembered the victim, and travels to dispose of the remains, or uses fire or water to dispose of the victim's remains; (9) the offender dismembered the victim, and travels, and uses fire, water, or containers, to dispose of the victim's remains; (10) the offender dismembered and buried the victim's remains.

The distance between the death location and disposal site were measured in miles via Google Maps as the quickest road route between the two locations. The distance was recorded as a scale variable. In addition, the distance between the victim and/or offender's home and the disposal location were recorded in the same way, in cases where such information was provided in media reports.

2.2.2. Independent variable (IV)

The IV in this study was the victim-offender relationship, which is defined as the relationship of the offender to the victim. These were reported in the media accounts and in the reports resulting from the FOI requests. The authors grouped the relationships into the following categories: intimate partner (current or former); family member (including parent; children; siblings; step-relatives); acquaintance (includes friends, neighbours, colleagues); stranger; or an "unknown" relationship. The designation of 'stranger' was given if this was how the relationship had been described in the media or FOI report. The FOI reports classified 'stranger' in accordance with the Homicide Index (ONS, 2026).

2.3. Data analysis

Data underwent several stages of analysis to provide a holistic exploration of the variables, and to address the project's aims. For both data analyses, we used IBM SPSS. Firstly, data was extracted to identify the prevalence of each variable, achieved through crosstabs. Secondly, data was analysed using the Chi Square Test of Independence allowing patterns to be identified amongst the non-parametric nominal IV and DVs. Findings were considered significant if $p < 0.05$. A Cramer's V was performed also, to validate the significant/insignificant results if the cell count expectations were violated and to provide effect size statistics, which is most appropriate following a Chi-Square test, and measures the strength of association between two nominal variables [60]. A final test was performed to amalgamate the data into groups that appear similar or occur concurrently, achieved through a Two-Step Cluster Analysis (TSCA). TSCA handles large data sets of 200 cases or more [61]; and can include both continuous and categorical variables [63. 64]. Cluster analysis has been shown to be useful for classifying and understanding homicide patterns, helpful for managing and preventing these crimes [63].

TSCA firstly clusters the data into hierarchical models, identifying which of the generated clusters have the strongest relationship [61,62]. This stage groups the data into clusters which have increased similarity and can be grouped together: if there is a dissimilar pattern within the variables observed, a new cluster is created [64]. The second stage of the TSCA is to identify if there is a goodness of fit between the variables, and the likelihood that they are similar, this is achieved through the log-likelihood measure owing to the use of predominantly categorical variables [61]. After performing these stages in SPSS, the result is a series of clusters that are recognised as similar within their groups, but dissimilar to the other clusters performed.

The purpose of performing the TSCA was to identify whether there were any possible groupings, or clusters, generated within the data set. This allows broad patterns and classifications within this new database to be uncovered (as identified by [63] and [65].

3. Results

A total of 228 non-serial, solved homicides from the UK were included within this study. 194 cases were obtained through open-source searches. Of the 43 FOI requests made to police forces in England and Wales, 11 replied positively, providing a further 34 cases that fitted the inclusion criteria.

3.1. Sample population

In the sample population, most of the victims were female (N = 160, 70.2%), and the offenders were predominantly male (N = 211, 92.5%).

Table 1 shows the relative frequencies of location of death, disposal method, disposal location, effort expended by offender, and the distances between death and disposal location, for each type of VOR.

Table 1
The descriptives and inferential results for each of the variables compared with the VOR.

	Victim-Offender Relationship							
	Descriptive statistics (n = 228)n (%)	Intimate Partner (n = 63, 27.6%)n (%)	Family member (n = 20, 8.8%)n (%)	Acquaintance (n = 82, 36%) n (%)	Stranger (n = 60, 26.3%)n (%)	Unknown (n = 3, 1.3%)n (%)	Chi-Square	Cramer's V
Homicide Phase								
Location of Death							X2 (28, 228) 145.6, p = 0.001	0.399
Victim's home (and associated properties)	42 (18.4)	12 (19)	6 (30)	18 (22)	5 (8.3)	1 (33.3)		
Offender's home (and associated properties)	51 (22.4)	10 (15.9)	2 (10)	34 (41.5)	5 (8.3)	0		
Victim & Offender's shared home	55 (24.1)	33 (52.4)	10 (50)	12 (14.6)	0	0		
Rural locations	40 (17.5)	2 (3.2)	0	14 (17.1)	23 (38.3)	1 (33.3)		
Urban locations	23 (10.1)	4 (6.3)	0	3 (3.7)	15 (25)	1 (33.3)		
Water	1 (0.4)	1 (1.6)	0	0	0	0		
Vehicle	3 (1.3)	0	1 (5)	0	2 (3.3)	0		
Unknown	13 (5.7)	1 (1.6)	1 (5)	1 (1.2)	10 (16.7)	0		
Post-Homicide Phase								
Disposal Method								
Body left where it was	26 (11.4)	1 (1.6)	0	7 (8.5)	17 (28.3)	1 (33.3)	X2 (24, 288) 57.5, p = 0.001	0.251
Hiding the body (Covered & Hidden)	39 (17.1)	9 (14.3)	1 (5)	10 (12.2)	19 (31.7)	0		
Concealing the body in a structure (suitcase, car boot)	43 (18.9)	12 (19)	7 (35)	17 (20.7)	7 (11.7)	0		
Disposal using fire or water	48 (21.1)	18 (28.6)	2 (10)	19 (23.2)	8 (13.3)	1 (33.3)		
Burial	35 (15.4)	12 (19)	6 (30)	12 (14.6)	4 (6.6)	1 (33.3)		
Dismemberment	35 (15.4)	10 (15.9)	4 (20)	16 (19.5)	5 (8.3)	0		
Unknown	2 (0.9)	1 (1.6)	0	1 (1.2)	0	0		
Disposal Location							X2 (28, 228) 58.5, p = 0.001	0.253
Victim's home (and associated properties)	25 (11)	8 (12.7)	5 (25)	8 (9.8)	4 (6.6)	0		
Offender's home (and associated properties)	26 (11.4)	4 (6.3)	3 (15)	17 (20.7)	2 (3.3)	0		
Victim & Offender's shared home	21 (9.2)	14 (22.2)	4 (20)	3 (3.7)	0	0		
Rural locations	84 (36.8)	20 (31.7)	3 (15)	30 (36.6)	29 (48.3)	2 (66.7)		
Urban locations	35 (15.4)	7 (11.1)	3 (15)	8 (9.8)	16 (26.7)	1 (33.3)		
Water	30 (13.2)	9 (14.3)	1 (5)	13 (15.9)	7 (11.7)	0		
Vehicle	3 (1.3)	1 (1.6)	0	1 (1.2)	1 (1.7)	0		
Unknown	4 (1.8)	0	1 (5)	2 (2.4)	1 (1.7)	0		
Effort expended by the offender to dispose of the victim's body (Effort score)							X2 (36, 288) 54.9, p = 0.023	0.245
1	24 (10.5)	4 (6.3)	0	5 (6.1)	15 (25)	0		
2	70 (30.7)	14 (22.2)	6 (30)	25 (30.5)	24 (40)	1 (33.3)		
3	35 (15.4)	12 (19)	4 (20)	13 (15.9)	5 (8.3)	1 (33.3)		
4	30 (13.2)	12 (19)	0	12 (14.6)	6 (10)	0		
5	19 (8.3)	6 (9.5)	4 (20)	6 (7.3)	3 (5)	0		
6	17 (7.5)	6 (9.5)	2 (10)	6 (7.3)	2 (3.3)	1 (33.3)		
7	5 (2.2)	1 (1.6)	0	2 (2.4)	2 (3.3)	0		
8	21 (9.2)	7 (11.1)	1 (5)	10 (12.2)	3 (5)	0		
9	3 (1.3)	1 (1.6)	1 (5)	1 (1.2)	0	0		
10	4 (1.8)	0	2 (10)	2 (2.4)	0	0		
Distance between death and disposal locations	0–224 miles (mean = 8 m, S. D. = 27.6)							

3.2. Inferential statistics

Several strongly significant relationships were found between the IV, the VOR, and the DVs chosen in this study. Table 1 shows the results of the Chi-Square and Cramer's V tests.

A strong significant relationship was found between the VOR and the location of death (X^2 (28, N = 228), 145.6, p = 0.001, V = 0.399). In our sample, current or ex-intimate partners most often committed the homicide in the home they shared with the victim (N = 33), which was also the case for family members (N = 10), whereas acquaintances used their own property (N = 34), and strangers used rural locations (N = 23).

The statistically significant relationship between the VOR and disposal location supports the finding that, irrespective of the VOR, rural locations (N = 84 of the total cases) were preferred for body disposal: (X^2 (28, N = 228), 58.5, p = 0.001, V = 0.253.) Acquaintances (N = 30) and strangers (N = 29) were most likely to utilise rural disposal locations, followed closely with current or ex intimate partners (N = 20).

A strongly statistically significant relationship was found between the VOR and the method of disposal: (X2 (24, N = 228), 57.5, p = 0.001, V = 0.251). Of all the categories of VOR, strangers most often left their victims' bodies where they died (N = 17) or covered or hid the bodies (N = 19).

Intimate partners (both current and former) disposed of their victims using fire or water (N = 18), followed by wrapping them or concealing them in a suitcase or car boot (N = 12). Family members mostly disposed of their victim's remains through either wrapping the body, or

concealing within a suitcase or car boot (N = 7) or through burials (N = 6).

Dismemberment and burials were only found in 70 cases in total. Acquaintances were most likely to dismember their victims (N = 16), whereas there were 12 partners and 12 acquaintances who buried their victims.

The coding of the effort expended by offenders allowed insight into the distribution of effort amongst the VOR categories (see Fig. 1). A weak significant relationship was found between the effort expended by the offender and the VOR: (X^2 (36, N = 228), 54.9, p = 0.023, V = 0.245), but some patterns were observed. The majority of offenders (30.7%) expended just more than the minimum effort (effort score 2), which involved a cursory attempt to cover the remains with easily available items such as twigs, leaves, or bin bags, for example. Strangers tended to expend the least effort (25% of stranger offenders scored 1 on the effort scale). Approximately a quarter of partner offenders (23.8%) and acquaintance offenders (25%) scored 6 or more on the effort scale. Of all the offenders in the sample, only two familial offenders (10%) and two acquaintance offenders (2.4%) expended the maximum effort (10 on the effort scale) by dismembering and burying their victims.

The distance travelled by the offender from the location of death to the disposal location was also examined (see Fig. 2). The majority of offenders, irrespective of VOR category, did not travel at all in order to dispose of their victim's body. The majority (89.2%) of intimate partner offenders and stranger offenders (91.7%) stayed within 10 miles of the death location, but a few (one partner offender (1.7%) and three stranger offenders (6.3%) travelled nearly 35 miles away from the death location. The maximum a stranger offender travelled to dispose of the victim's remains was 40 miles. However, in the familial and acquaintance VOR categories, offenders were willing to travel greater distances. Three acquaintance offenders travelled over 50 miles (86, 205 and 224 miles), and three familial offenders (15.8%) travelled over 100 miles (106, 145 and 150 miles), indicating a greater desire to literally distance themselves from their crimes, victims' bodies and to delay or thwart detection.

4. Two-step cluster analysis (TSCA) results

The TSCA amalgamates the different cases within the sample into clusters, identifying which of the cases have similar attributes. If the TSCA identifies similar patterns within the cases, they are grouped into one cluster. If there are similar patterns between another group of cases, then a new cluster is formed. The hierarchical model (the second stage of the TSCA method) determines which of the identified clusters have the strongest relationship. In this sample, 204 cases of the sample (or 89.13% of the data set) were clustered into four distinct clusters constituting cases with similar attributes, based on the variables inputted for analysis (variables: the VOR; the location of death, the disposal location and method, and the distance travelled between the death and disposal locations).

4.1. Cluster 1 (53 cases [25.9%])

Acquaintances' rural disposal

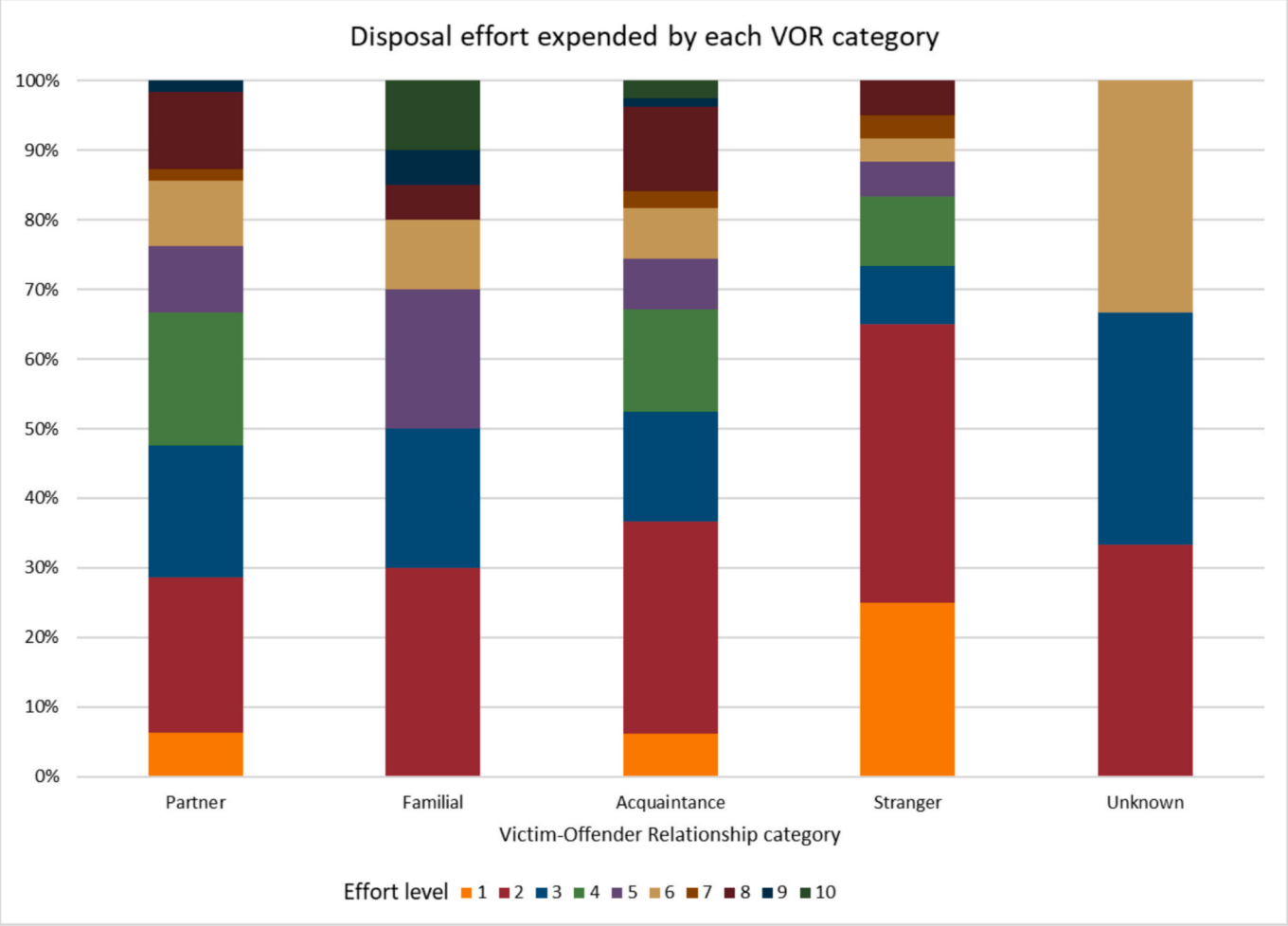

Fig. 1. Graph to show the relative effort expended by each VOR category.

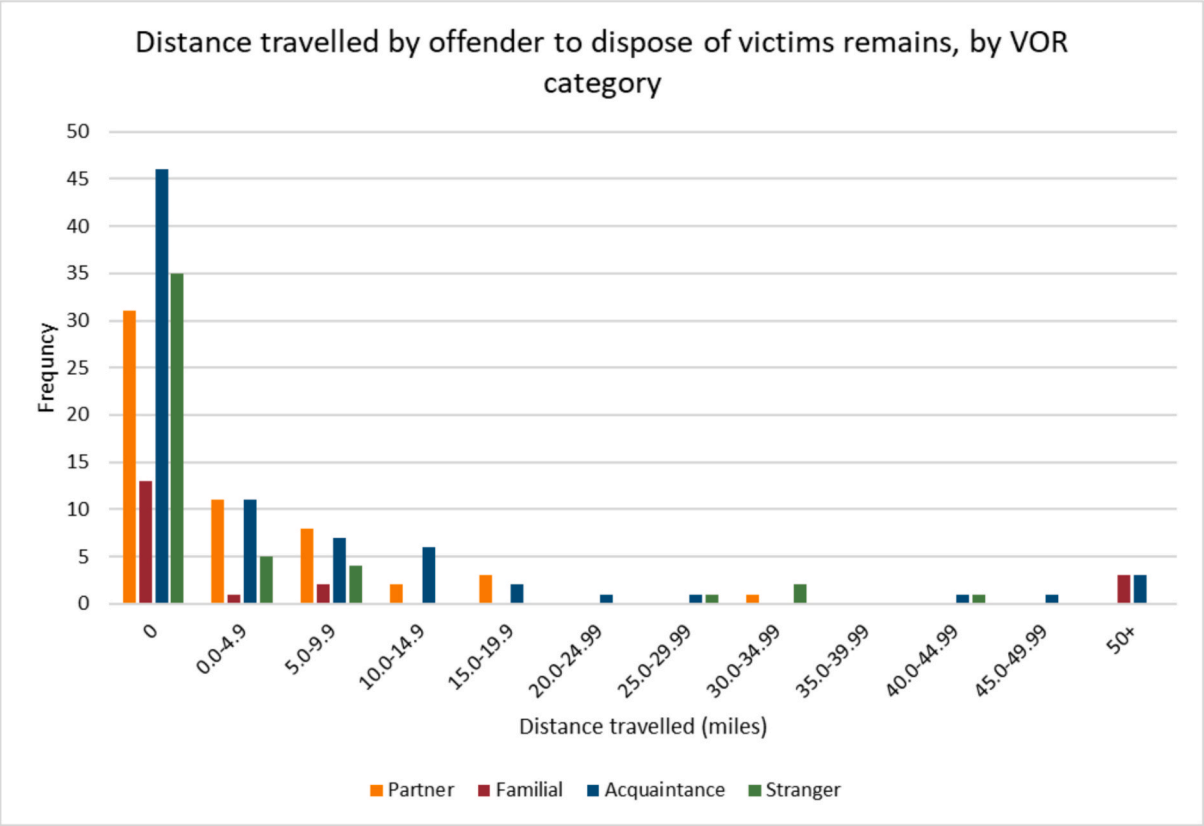

Fig. 2. Graph to show the distance travelled by the offender to dispose of the victims' remains, by VOR category.

Within this cluster, the victims were predominantly an acquaintance (43.4%) to the offender(s). 54.7% of victims were killed in the home that they shared with the offender(s), but their body was recovered from a rural location (50.9%). The mean distance between the location of the victim's death and where their body was subsequently recovered was 20.5 miles. 47.2% of victims were found dismembered.

4.2. Cluster 2 (67 cases [32.7%])

Domestic disposal

In this cluster, the VOR was predominantly characterised as current or ex intimate partners (47.8%). The victim was killed in their properties (35.8%) and disposed of within their properties also (26.9%). The victims were disposed of using either fire or water (62.7%). The mean distance between the death and disposal location was 4.04 miles, indicating that the offender moved the victim's body to one of the victim's other accessible properties (e.g., holiday let, caravan, or rented accommodation).

4.3. Cluster 3 (55 cases [26.8%])

Strangers' rural disposal

In this cluster, 69.1% of the cases involved an offender who was a stranger to the victim. The victims in the sample were predominantly murdered in a rural location (49.1%) and 50.9% were recovered from a rural location also. The victims' bodies were predominantly covered or hidden by the offender (40%), using material close by (e.g., leaves, rubble, snow). The mean distance travelled between the death and disposal location was 3.56 miles. The mean distance travelled can be explained by the following case within the sample: a female victim was killed in a large national park. After her death, the offender dragged her body further into the park, presumably away from the park's entrance where she would be easily seen by park visitors. There were no further attempts at covering, hiding, or otherwise disposing of the victim's body. This example can explain why there may be some travel between death and disposal locations.

4.4. Cluster 4 (30 cases [14.6%])

Acquaintances' property disposal

Acquaintances within this cluster (76.7%) could be neighbours, friends, criminal associates, or work colleagues. This suggests that there is a degree of familiarity between the victim and offender, but not as close a relationship as between intimate partners or family members. Within this cluster, 90% of victims were killed in property owned by the offender, and 76.7% were also disposed of in the offender's properties. There was a mean distance travelled of 2.13 miles between the death and disposal locations. The victims were recovered either hidden, placed into a suitcase, or car boot (66.7%).

In a scenario where a person has gone missing and a homicide is suspected, but remains have not yet been found, and the VOR is known, our cluster analysis can aid the prediction of the location of the victim's body and the likely disposal method. From the TSCA, we have devised a flowchart which helps search efforts when the suspect has been identified, but the victim's remains have not yet been recovered. Fig. 3 shows how the cases with shared characteristics can be used to predict the likelihood of certain combinations of disposal location and method, based on the known VOR. The flowchart starts with knowledge of the victim and (suspected) offender relationship. Once this is known, searchers and investigators should examine the death locations for forensic evidence. For example, if the offender is thought to be a stranger and the death location is rural, then the most likely disposal location is rural, and the body is most likely to have been left where it was, or less than five miles away from the death location. Or, for current or ex-intimate partners, search strategies should thoroughly examine the shared home to identify any forensic evidence opportunities. Similarly

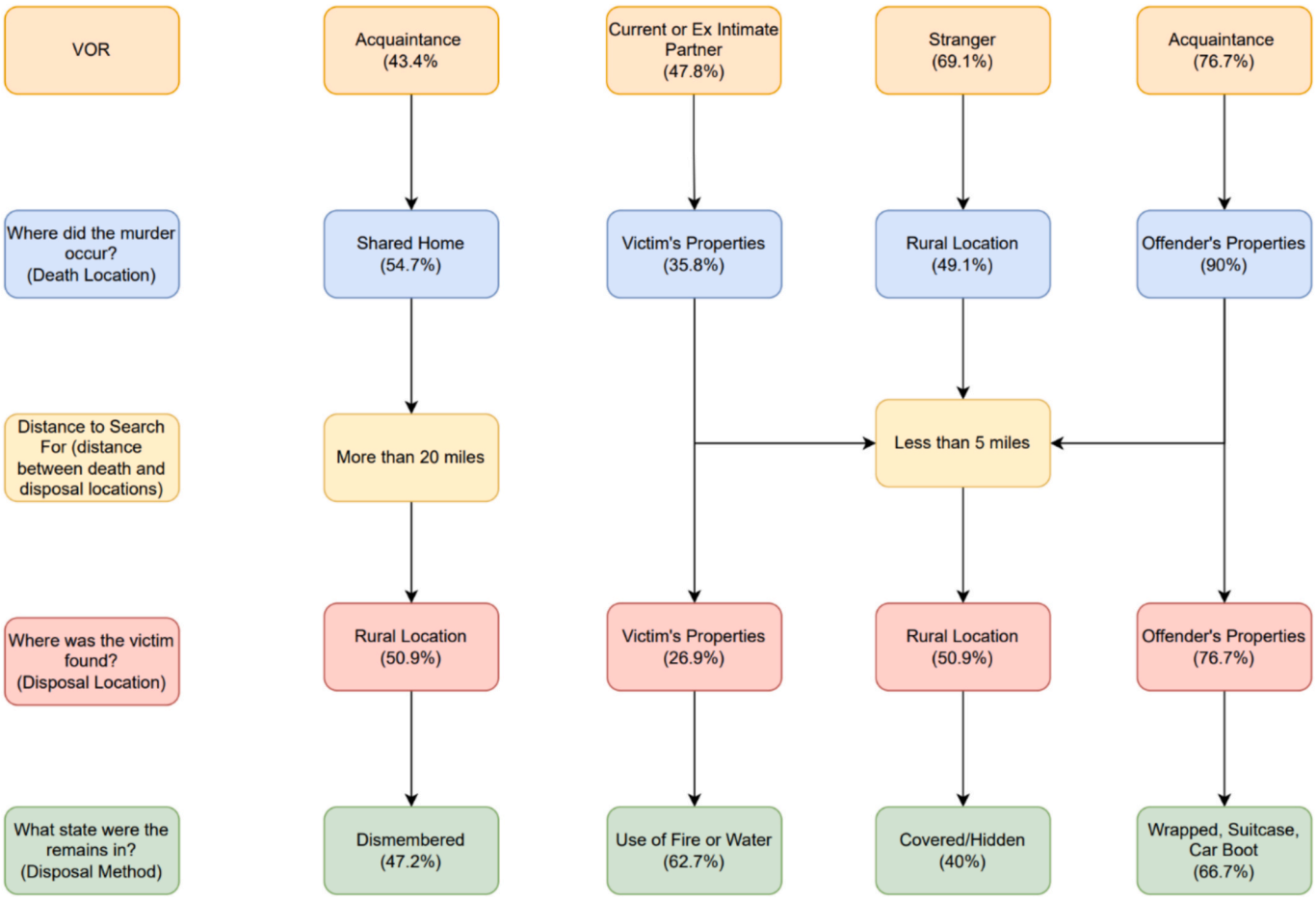

Fig. 3. A flowchart to show the patterns observed in the sample population as a result of Two-step Cluster Analysis.

for current or ex-intimate partners, searchers should focus on a 5 mile or less radius to locate the victim's remains, and should consider searching any properties which belong to the victim (e.g., caravan, hostel etc.). It is possible, from this sample, that the offender(s) used fire or water to conceal their victim's remains or prevent or delay recovery.

This flowchart can also be used in reverse, beginning with the discovery of the victim's remains. The state of the remains and where they were recovered can be a starting point for locating the murder location and prediction of the likely relationship between the victim and offender. For example, if the victim was found dismembered in a rural location (e.g., woodland), the searchers and investigators should ensure a wide search radius because there is possibility that the offender travelled a significant distance from the original murder location to dispose of the victim's remains. Identifying the victim will help narrow the searches, and the focus should be the victim and offender's shared home. Here, evidence may be recovered indicating this is the location of death and our sample suggests that the offender is someone living with the victim, such as an acquaintance (e.g., a housemate).

5. Discussion

This study aimed to identify patterns of body disposal in solved UK homicides, determining if the VOR impacts the methods and efforts made to dispose of a victim's body. While previous studies have explored body disposals, these primarily originate from within the USA, or explore either serial or sexual offences only. Through examination of 228 solved UK non-serial homicides, obtained from open-source methods, which involved a form of body disposal, this study characterised the role that the VOR has on body disposal methods and efforts.

The results represent a subset of homicide cases from the UK. Of the approximately 500–700 homicide cases that occur in England and Wales each year, only about half are solved [63]. Australian studies [66] suggest that an element of disposal or concealment occurs in roughly 8% of homicide cases, but comparable data from the UK is lacking.

The results show mostly female victims and male offenders feature in the sample, with 'acquaintance' and 'current or ex intimate partner' being the most prevalent VOR in solved, non-serial UK homicides. While the homicides in this sample most often occurred in private, indoor areas, body disposal was mostly in rural locations. The use of fire and water were the most used disposal methods across the sample, followed closely by wrapping the body, or concealing with a suitcase or car boot. The inferential statistics showed that acquaintances most often killed their victims in their own properties, or in the victim's home but subsequently disposed of the bodies in a rural location, using methods such as fire or water, or wrapping the body, concealing within a suitcase or car boot. Strangers typically, within this sample, killed their victims in a rural location and subsequently disposed of them in a rural location, often tending to cover or hide the body with easily accessible material (e.g., rubble, snow, leaves etc.) or simply leaving the body where it is, showing no attempt to conceal the remains. Current or ex intimate partners most often killed their victims in the home that they shared with the victim, but then disposed of their victim's remains in a rural location, using either fire or water to dispose of the remains. Familial offenders were most likely to kill the victim in the home that they shared with them, before disposing of them in either the shared home or the victim's properties. Familial offenders were found to use wrapping, concealment in a suitcase or car boot, or burials as a means of disposing of their victim's body.

While previous studies have explored body disposals and concealment efforts, these primarily originate from the US or Australia, and explore either sexual or serial offences,[e.g., [9,13,39]. Thus, their applicability to single-victim and offender homicides in the UK is limited. Further, these studies consider different factors surrounding homicide and subsequent body disposal in isolation, and do not consider several variables in one analysis and focus on the type of offence primarily. Beauregard and Chopin [67] argue that most of the typologies and classifications regarding different types of homicides (e.g., serial vs. non-serial) do not always provide actionable directions for those needing to interpret research findings, and so there might be limited practical applications of research studies.

Most victims in the sample were female, with some associated with the offender prior to the homicide. Female victims were also found to be most prevalent with other studies [e.g., [68,69]. Strangers and partners represent the second and third most populous VOR with this sample. Research has found that strangers target victims in outdoor locations [70]. Within Morton and colleagues' [9] study of 408 US serial homicides, the victim-offender relationship consists of customers/clients, strangers, and acquaintances most often. An earlier study by Beauregard and Field [13] found that the closer the relationship between the victim and offender, the greater the likelihood of the bodies being simply left where the murder took place. In this study, we found the opposite trend, as it was strangers to the victims in our sample who were most likely to leave the body where they fell and were the least likely to conceal and dispose of their victims. However, our study did not include serial homicides, unlike Morton et al.'s [9] exploration. They reported greater numbers of disposal and concealment of victims in their study, but this may be a result of their inclusion of serial killer cases and may not reflect what happens in single homicide cases.

We also explored the efforts made by the offenders to either conceal or dispose of their victims. We discovered that intimate partners (76.2%) and strangers (88.3%) expended the least effort in body disposal (effort score 5 or less). This concurs with literature that suggests that current and former intimate partners are more likely to commit unpremeditated murder or 'crimes of passion' and not spend time or energy on the disposal of the body afterwards [e.g., [71]. The lack of effort expended by strangers may indicate a high level of confidence in not being linked to the victim, and avoiding detection as a result. In our sample, it appeared that offenders who were family members or acquaintances of the victim were more likely to expend more effort (scoring 6 or more on the effort scale) and travel much further to dispose of their victim's remains. It was only offenders in these VOR categories that expended the maximum effort (on our scale) by both dismembering and burying their victims.

Our findings support the work of others in terms of distance travelled by offenders to dispose of their victims. The vast majority of the offenders in our sample did not travel at all (0 miles) or travelled fewer than 5 miles from the site of the murder. In contrast to Hakkanen et al [8], we found that acquaintances were the VOR group most likely to travel the greatest distance to dispose of their victim's remains.

A further analysis of the data was a Two-Step Cluster Analysis, which sought to determine which of the study's variables were similar and could be grouped together. 204 cases in the sample were included into four distinct clusters. The cluster analysis allowed similar disposal and concealment methods and efforts to be grouped by the VOR. The flowchart devised by the findings of the TSCA allow for investigators to narrow their searches, to either recover the victim's remains or determine who the offender(s) is.

5.1. Limitations

While there is no UK database for adults involving some form of disposals [72], it is only possible to collate this data from a non-invasive open-source methodology approach. However, this does pose limitations in ensuring that all applicable homicides are captured. While rigorous searching methods were adopted for this study, there is a chance that some cases, which typically did not obtain substantial media coverage, are missing from analysis. We were only able to capture cases which were reported within media outlets. Further, the FOI approach is underpinned by legislation which places restrictions on the time that can be spent collating applicable data. This partly explains why there was a limited response rate from the police forces.

The definition of "acquaintances" was intentionally broad in this study, and includes neighbours, family friends, or colleagues. This decision was made to maximise the sample number in each group to elucidate broad differences. In future work with a larger sample size, it may be helpful to differentiate between particular types of acquaintances to determine if there are more specific patterns of body disposal, concealment and the efforts made by people in this category. It is likely that different patterns will emerge relating to the comparative sexes of the victim and offender. Further, because of the limitations in information which is publicly available for sensitive matters, like the cases covered within this study, we focussed on extracting information which was accurately reported. This meant that some variables which would be worthwhile for this topic were not included for analysis, like use of vehicles, motives, and specific times between death and discovery. These gaps could be addressed in future research with collaborations with law enforcement professionals. A database like that maintained by law enforcement for sexual homicides (the Sexual Homicide International Database: SHIeID) [73] would be beneficial for further research in a UK-specific context.

We have highlighted a hitherto under-represented area of enquiry for homicide investigations involving disposal, using innovative methods. However, as this was an exploratory study, seeking to identify methods and efforts of body disposal, and establish proof of concept in the UK, the 228 cases may not be representative of all homicide cases involving body disposal, particularly as they do not include serial killer victim disposals. Thus, our findings should be considered as the first step in exploring this practice, from which other studies can springboard, to facilitate stronger predictions in future.

6. Conclusion

Although this is a preliminary, exploratory study, it is the first of its kind in the UK. Its purpose was to identify body disposal patterns in solved UK homicide cases, while considering if there was an association between the VOR and the effort and method of body disposal. Our intention was to predict whether disposal type and body disposal location may assist body recovery if the victim-offender was known, or to predict the relationship once the body was located. We have found statistically significant relationships between the VOR and the location of death and the disposal method employed by the offender. In particular, we found that strangers were most likely to kill their victims in rural locations, leave their victims where they fell, and not spend much effort trying to dispose or conceal the remains. Intimate partners spent a little effort, and did occasionally resort to the use of fire or water for disposal. Neither group tended to travel more than 10 miles away from the site of the murder. In contrast, offenders who were family members or acquaintances of the victim were most likely to travel long distances and expend more effort to dispose of their victim's remains, through concealment, dismemberment and burial. These findings have important implications for our understanding of the behaviour of non-serial offenders in the UK, which can be used to inform search and location strategies in scenarios where the body has not been found but the VOR is suspected or known, or to enable prediction of the VOR once a body has been found. We suggest that our findings could be utilised by homicide investigators and forensic personnel to tailor and target searches for victims' remains when the VOR is known, leading to shorter, more successful searches, lower search costs and better outcomes for the bereaved.

7. Recommendations

We propose the following practical recommendations to help inform and strengthen search strategies in the UK. Our findings could complement and enhance existing geographical and behavioural profiling approaches. We have also made some suggestions regarding the potential focus of further work to build on our preliminary results.

A centralised database including VOR as a recorded variable should be created, expanding on our study, which can aid investigators to track patterns, as reported in documents like iFind. Currently, the database is only applicable to murdered victims under 21 years old, with some element of disposal and concealment, in the UK (CATCHEM database, managed by the National Crime Agency). Thus, a new database for over 21 s, with records of VOR, disposals, and concealments should be generated, in collaboration with police forces.

The results within this study may be suitable for helping to solve currently unsolved or 'cold' cases, where the victim's remains have not yet been recovered, or nobody has been prosecuted successfully. Our results may give investigators/reviewers new insights in terms of possible disposal locations in these unsolved cases. They could help narrow down suspect lists, identify suitable search parameters and help recover the victim's bodies more quickly, improving forensic evidence and outcomes.

The results from this study could be incorporated into the "Manning cost-benefit tool" [74], to identify cost reduction strategies in cases involving disposal and concealment. A template is provided by the College of Policing for identifying cost-reduction strategies in cases that follow certain patterns, as highlighted in this paper. This could help to reduce wider costs associated with investigation of homicides involving concealment and disposal.

Further studies based on access to police records could incorporate more variables of importance (e.g., use of substances, motive, offender's history, and victim vulnerabilities), which can provide more explicit direction to inform search strategies and law enforcement personnel. These findings can be incorporated into mechanisms such as iFind.

It would be beneficial to expand on the TSCA clusters identified here to situate the findings into more complete typologies, which collectively consider the offender "types" [e.g., [75] body concealment [76] and the transportation of bodies [77]. Our study has bridged gaps in terms of distances travelled, which Chai et al. [78] recognised as a limitation and gap in existing studies, particularly in single-victim, single-offender homicides.

Rational Choice Theory (RCT) [79] is a common theory through which to understand homicide, associated behavioural patterns, and disposal/concealment techniques [e.g., [80]. This can be applied to the TSCA clusters to strengthen the understanding of the offender's decision-making choices when employing disposal and/or concealment methods.

Ethics statement

Ethics approval was granted in 2020 by Leeds Beckett University (this was the prior institution of the lead author for this project

We used only open source methodologies for this project, but still submitted ethics approval as a secondary project.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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