

# The stranger you know: predicting victim-offender relationships in sexual homicides by comparing offender behaviors by crime location

Zena Rossouw, Eric Beaugard and Julien Chopin

## Abstract

**Purpose** – Although crime location is known to matter in sexual homicides, it remains unclear whether predictors of the victim-offender relationship differ between indoor and outdoor settings. This exploratory study aims to examine whether these predictors distinguishing stranger and offenders known to the victim vary across crime scene locations.

**Design/methodology/approach** – The sample included 440 solved adult sexual homicides (victim ages 16–65) from France and Canada. Chi-squared tests assessed the relationships between variables and the victim-offender relationship (stranger = 1, known = 0) across three groups: all cases (n = 440), indoor cases (n = 289) and outdoor cases (n = 151). Statistically significant predictors with sufficient case counts were then entered into logistic regression models for further analysis.

**Findings** – Strangers were more likely to bring a weapon, have the victim perform fellatio, and remove items from the scene. Offenders known to the victim were more likely to target specific victims and engage in overkill. When analyses were stratified by crime scene location, the indoor model results were similar to the overall findings; however, when the offender moved the victim's body post crime, the offender was more likely to be someone known to the victim. However, fewer behaviors significantly distinguished stranger and known offenders in outdoor sexual homicides.

**Originality/value** – To the best of the authors' knowledge, this study is the first to examine behaviors predicting the victim-offender relationship separately for indoor and outdoor crime scenes, highlighting the importance of context when interpreting offender behavior.

**Keywords** Rational choice, Sexual homicide, Victim-offender relationship, Behavioral profiling, Crime scene, Offender behavior

**Paper type** Research paper

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## Introduction

On Christmas Day in 1996, six-year-old JonBenét Ramsey was found murdered inside the basement of her family home. Despite nearly 30 years of investigation and over 21,000 tips, the case remains unsolved (City of Boulder, 2026). There is an ongoing public debate as to whether her killer was someone she knew.

Statistically, homicides that occur indoors are more likely to involve an offender known to the victim, whereas those occurring outdoors often involve strangers. This pattern also appears in studies of sexually violent crimes (Chan, 2024; Lovell *et al.*, 2016; Rossmo, 2023). During investigations, however, law enforcement must assess the available evidence and information, which is often limited, leaving them with countless possibilities to consider.

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Understanding the predictors of the victim-offender relationship can help narrow down these possibilities (e.g. [Greenall and Wright, 2020](#); [Chan, 2024](#); [Kim et al., 2024](#)).

An unresolved question, however, is whether predictors identified in prior research should be interpreted the same way for sexual homicides occurring indoors and outdoors. In practice, sexual crime analysts have noted that because offence location informs which behaviors they consider for inclusion in their analysis, they need research that clarifies what is common in indoor crimes and how outdoor crimes should be understood ([Davies et al., pp. 240, 247](#)). If law enforcement is to use predictors of the victim-offender relationship to assess whether an offender is likely a stranger or someone known to the victim, it is important to know whether these predictors apply similarly across crime scene locations. Although research has examined behavioral and situational predictors of the victim-offender relationship, to the best of our knowledge no empirical study has yet examined whether these predictors differ when analyses are stratified by crime scene location (indoor vs outdoor).

Guided by the rational choice theory and previous research on situational decision-making ([Cornish and Clarke, 1986, 2017](#); [Rossouw et al., 2024](#)), this study examines whether predictors of the victim-offender relationship vary by crime scene location. The analysis draws on a data set of solved adult sexual homicide cases (victim ages 16–65) from France and Canada, where the victim-offender relationship is known. We specifically excluded cases involving victims engaged in the sex trade, as these cases have unique characteristics that require separate analysis ([Quinet, 2011](#)). The study assesses whether commonly cited behavioral indicators differ across indoor settings (e.g. residences or office buildings) and outdoor settings (e.g. parks or parking lots). The analysis first evaluates predictors across all cases, then compares patterns separately for indoor and outdoor crime scenes.

### Investigative decision-making

As homicide clearance rates decline across the USA, and data-informed policing strategies gain popularity, both investigative and academic communities are increasingly focused on improving the understanding of crime scene behaviors ([Davies et al., 2018](#); [Douglas et al., 2006](#); [Greenall and Wright, 2020](#); [Pecino-Latorre et al., 2019](#); [Rossmo, 2023, 2025](#)). This topic is particularly important in the context of sexual homicides, which although rare, represent a high-stakes crime that often requires investigators to make decisions based on incomplete information and limited experience ([Beauregard and Martineau, 2012](#)).

Sexual homicides account for less than 4% of all murders in North America ([Chan et al., 2012](#); [Meloy, 2000](#); [Roberts and Grossman, 1993](#)). Despite their rarity, these crimes have a significant impact on society and put considerable strain on the criminal justice system ([DeLisi et al., 2010](#)). The infrequency of sexual homicides, coupled with the media attention they receive, adds pressure for law enforcement to solve these cases quickly ([Rossmo, 2025](#)). Making fast decisions under pressure, especially with limited information, can lead to errors in judgment ([Kahneman, 2011](#)). According to [Kahneman \(2011\)](#), this is when we tend to rely on mental shortcuts. While these shortcuts can be useful for making quick decisions, they are also susceptible to systematic errors and biases.

To reduce the risk of judgment errors and assist in decision-making under uncertain conditions, law enforcement typically relies on trained professionals, research, historical case patterns and behavioral profiling ([Beauregard and Chopin, 2025](#); [Davies et al., 2018](#)). Two common methods used are behavioral profiling and crime linkage analysis. Behavioral profiling, a technique developed by the Federal Bureau of Investigation (FBI), involves assessing an offender's behavior to infer unknown characteristics and predict future actions ([Douglas et al., 2006, p. 405](#)). Crime linkage analysis involves identifying crimes likely committed by the same individual ([Davies et al., 2018](#)). Although these two methods serve different purposes, they overlap in that understanding an offender's profile can aid in

identifying similar crimes, and vice versa. While some critics argue that these methods can be overly subjective, these methods function best when grounded in empirical research (Beauregard and Chopin, 2025; Davies *et al.*, 2018). That is because a well-informed strategy is necessary, as both tools are intended to help narrow down suspect lists and improve investigative decisions (Adjorlolo and Chan, 2017; Beauregard and Chopin, 2025; Canter *et al.*, 2004; Crabbé *et al.*, 2008; Davies *et al.*, 2018).

## Typologies of sexual murder

To better understand the behaviors common in sexually violent crimes, researchers categorize sexual murderers into different typologies. Typologies are groups of offenders with shared characteristics related to their motivations, personalities and victim selection (Beauregard and Chopin, 2025; Chan *et al.*, 2012; Douglas *et al.*, 2006; Higgs *et al.*, 2017). These typologies serve as a practical tool for organizing crime scene behaviors and communicating patterns among practitioners (Douglas *et al.*, 2006).

The FBI was the first organization to classify sexual offenders into three types of offenders: organized, disorganized or mixed (Douglas *et al.*, 2006; Ressler *et al.*, 1988). The categories were later criticized for lacking empirical support (Canter *et al.*, 2004). Since then, research has expanded and many new offender typologies have been proposed. Beauregard and Chopin (2025) identified at least 19 different typologies, while Chan and Myers (2025) reported that 13 empirically derived classifications specific to nonserial or single-victim male sexual homicide offenders have been identified since 2010. Together, this work reflects both progress and increasing complexity in the field.

Recent reviews suggest growing agreement around three main typologies for male sexual homicides involving adult victims: sadistic, grievance-driven (angry) and opportunistic (rape-murder). Among these, the sadistic and angry types show the most consistent behavioral patterns and are especially relevant for distinguishing between stranger and known offenders (Beauregard and Chopin, 2025; Higgs *et al.*, 2017).

*Sadistic typology:* Individuals classified as “sadistic” are more likely than other types to select victims who are strangers to and offend in locations that offer access to potential victims and privacy for the offense (Beech *et al.*, 2005; Chopin *et al.*, 2020; Dietz *et al.*, 1990; Higgs *et al.*, 2017). These incidents are often premeditated (67%–81%) and involve prolonged interactions with the victim(s), which include humiliating acts such as mutilation and oral sex (Beauregard and Proulx, 2002; Dietz *et al.*, 1990; Stefanska *et al.*, 2015; Higgs *et al.*, 2017). Just over a third of sadistic offenders take items from their victims (Balemba *et al.*, 2014; Dietz *et al.*, 1990; Higgs *et al.*, 2017). While overkill is not common, when it does occur, it can be part of a fantasy or a desire for control (Chopin and Beauregard, 2021; Stefanska *et al.*, 2015).

*Angry typology:* In contrast, angry (grievance-driven) sexual homicides are more likely to involve victims known to the offender (Gerard *et al.*, 2007; Higgs *et al.*, 2017). These incidents often arise from escalating interpersonal conflict, sometimes following previously consensual interactions, and are more likely to involve offender intoxication (Beauregard and Proulx, 2002; Beech *et al.*, 2005; Higgs *et al.*, 2017; Stefanska *et al.*, 2015). Compared to sadistic offenses, angry sexual homicides are less likely to be planned and more likely to reflect impulsive or emotionally driven behavior.

Like the FBI’s “mixed” typology, the rape-murder (opportunistic) type features a mix of behaviors that could align with either the sadistic or angry category (Beauregard and Chopin, 2025; Meloy, 2000; Higgs *et al.*, 2017).

## *Crime location and the relationship to the victim*

While typologies help organize offender behaviors into broad categories, their practical value depends on whether they can meaningfully guide investigative decisions. As

Adjorlolo and Chan (2017) argue, typologies are most useful when crime scene behaviors reliably align with specific offender profiles. Yet many classification systems still fall short in providing actionable direction, particularly when it comes to interpreting behaviors across different crime settings and contexts (i.e. single vs serial offenders, child vs adult victims) (Beauregard and Chopin, 2025; Chan and Myers, 2025).

To understand offender behavior, particularly how offenders select victims and crime locations, it is useful to apply the Rational Choice Perspective (RCP). This perspective holds that offenders make decisions based on perceived costs and benefits, within constraints such as limited time, information and awareness of risk (Cornish and Clarke, 1986, 2017). This concept of “bounded rationality” shifts attention from why offenders act to how they make decisions within specific contexts (Cornish and Clarke, 2017; Eck and Weisburd, 2015).

Place plays a central role in these decisions. Offenders cannot target victims in locations they do not know exist or do not feel comfortable navigating (Eck and Weisburd, 2015; Rossmo, 2025). And behaviors cannot be interpreted in isolation, and therefore the context of the events leading to and during the crime matters. The meaning of a behavior, such as bringing a weapon or moving a body, may shift depending on whether the crime occurred indoors or outdoors (Douglas *et al.*, 2006; Warr, 1988; Salfati and Canter, 1999). For example, strangers may adjust their approach based on visibility, distance to the victim or perceived resistance, which can influence weapon choice and control strategies (Beauregard *et al.*, 2007; Rossouw *et al.*, 2024).

Recent research supports this context-sensitive view. Chan (2024), drawing on RCP and routine activity theory, examined how sexual homicide offenders select victims and locations, and which decisions predict the victim–offender relationship. Using 31 years of case files from China ( $n=127$ ), Chan found that stranger offenders were more likely to offend outdoors and have prior sexual convictions. Similarly, Kim *et al.* (2024), using a sample of sexual homicides from France and Canada, found that stranger offenders were more likely to use weapons and premeditate the attack; while known offenders were more opportunistic, using their relationship to gain access. While location alone did not predict whether the offender was known to the victim, it became meaningful when combined with situational factors, such as the victim’s activity before the attack. Both studies found that the location of the crime was of significance. However, because these studies did not distinguish between indoor and outdoor scenes, it remains unclear whether the predictors retain their significance when analyzed by crime location. In other words, do behaviors that predict stranger-perpetrated homicide, such as engaging in oral sex or using a weapon, have the same implications when the crime occurs indoors versus outdoors?

### The current study

This study examines how predictors of the victim–offender relationship in sexual homicides differ by crime scene location, focusing on indoor and outdoor settings. Prior research has typically combined these cases, which may have obscured differences relevant to investigations and prevention. This study responds to recent calls for research on situational contexts in sexual violence (Chan, 2024, p. 609; Davies *et al.*, 2018, p. 240; Kim *et al.*, 2024) and to Cornish and Clarke’s (2017) argument that decision-making research on crime locations should extend beyond property crime to consider how context can shape different decisions for the same type of offense (Cornish and Clarke, 2017, *Empirical Studies of Criminal Decision Making*, para. 2).

Crime location is especially important from an investigative perspective. Outdoor crime scenes present distinct investigative difficulties, which complicate efforts to infer the victim–offender relationship. As Detective David Reichert observed in reference to Green River Killer case, “The cases you dread the most are homicides in outdoor settings where

there are no witnesses, little physical evidence, and no indication of a relationship between the killer and the victim” (Reichert, 2004, as cited in [Bichler et al., 2017](#), p. 133). Clarifying how context influences offender behavior is therefore a logical next step.

The study addresses two questions:

- Q1. Do predictors of the victim–offender relationship in sexual homicides of adult victims differ when cases are analyzed collectively versus when separated by indoor and outdoor locations?
- Q2. Which predictors serve as significant indicators of the victim–offender relationship in (a) a collective analysis, (b) cases occurring outdoors, and (c) cases occurring indoors?

Guided by the rational choice perspective and prior findings, we anticipate that predictors will differ across crime settings. Offenders adapt their behavior based on opportunities and constraints unique to each environment. As a result, the context in which a crime occurs may alter not only how it unfolds, but also what those behaviors mean for understanding who the offender is.

## Methods

### Sample

The study sample was drawn from the Sexual Homicide International Database (SHIeID), which included 762 cases of sexual homicide from France ( $n=412$ ) and Canada ( $n=350$ ) between 1948 and 2017. Analysts trained in violent crime coding entered each case into the system ([Chopin and Beauregard, 2019](#)). All met the following criteria:

- completed homicides only (no attempted homicides);
- involved a single offender; and
- included at least two sexual elements (i.e. evidence of sexual activity or motivation).

A “sexual element” was identified using the FBI’s criteria, which included (a) the victim’s attire or lack thereof; (b) exposure of sexual parts; (c) sexual positioning of the victim’s body; (d) insertion of foreign objects into body cavities; and (e) evidence of other sexual activity, interests or sadistic fantasies ([Chopin and Beauregard, 2019](#); [Ressler et al., 1988](#)).

To minimize contextual differences the sample focused on adult victims aged 16–65 who were not involved in the sex trade. We limited our sample to adults based on recommendations from prior research, prior research recommendations, which indicate that sexual homicides involving children, older adults, and those in the sex trade follow different crime scripts and situational dynamics (e.g. [Beauregard and Chopin, 2025](#); [Chan and Heide, 2009](#); [Chan and Myers, 2025](#); [Chopin and Beauregard, 2020](#); [Quinet, 2011](#)). In addition, since the study examined the relationship between victim and offender, the analysis was limited to solved cases only; unsolved cases were excluded. This resulted in a final sample of 440 cases.

### Case and victim characteristics

The sample included 440 male offenders who committed sexual homicides, all of which were solved by law enforcement. Most cases were opposite-sex sexual homicides (85.5%,  $n=376$ ; male offender–female victim), while the remaining cases were same-sex sexual homicides (14.5%,  $n=64$ ; male offender–male victim). The average age of the victim was 31.24 years ( $SD=12.83$ ) across all cases, 29.09 years ( $SD=11.81$ ) for outdoor cases, and 32.37 years ( $SD=13.22$ ) for indoor sexual homicides. A little over half of the homicides (53.9%,  $n=237$ ) were committed by known offenders, while 46.1% ( $n=203$ ) involved strangers. Most incidents occurred indoors (65.7%,  $n=289$ ), whereas just over a third happened outdoors (34.3%,  $n=151$ ).

### *Ethical considerations*

This study used secondary, de-identified data from the Sexual Homicide International Database (SHIeID). All identifying information was removed prior to analysis. Texas State University Research Integrity and Compliance determined on July 14, 2025, that the project did not constitute human subjects research (Protocol #10284); therefore, a research ethics review was not required.

### **Measures**

#### *The dependent variable*

The dependent variable is a dichotomous variable which indicates the relationship between the offender and the victim (1 = stranger, 0 = offender known to victim). A stranger is defined as someone who has no known relationship or familiarity with the victim at the time of the crime (Chan, 2024, p. 611; Chopin and Beauregard, 2021, p. 48). A known individual has a prior relationship with the victim, which may include an intimate partner, family member, friend, colleague, among others (Chan, 2024, p. 622).

#### *Independent variables*

The selection of independent variables was guided by prior research indicating that certain victim characteristics are predictive of the victim-offender relationship. Since the goal of this study is to provide practical information for law enforcement practitioners, we also considered whether the variables would likely be observable at the crime scene. We focused on three main areas: 1) victim characteristics, 2) offender behaviors during the crime, and 3) their behavior post crime. Our goal was to identify predictive factors that may vary based on whether the crime occurred indoors or outdoors, since previous findings show the location of the crime can serve as a predictor of the victim-offender relationship (Chan, 2024). We analyzed 15 dichotomous variables (0 = no; 1 = yes) shown in earlier studies to be common among stranger and non-stranger offenders (Chan, 2024; Chopin and Beauregard, 2021; Higgs *et al.*, 2017; Keppel and Walter, 1999).

*The victim characteristics:* We included three specific victim variables:

1. whether the victim was female;
2. whether the victim lived alone; and
3. whether the victim experienced substance abuse or psychological disorders.

*The offender's behaviors throughout the crime:* When interviewed, individuals who commit sexual offenses cite several factors that influence their decisions, including location, availability and victim vulnerability (Beauregard *et al.*, 2007). Their approach to selecting a victim varies depending on these factors (Rossouw *et al.*, 2024). For instance, outdoor offenses involving strangers typically rely on deception to gain access to the victims (Beauregard *et al.*, 2007; Chan, 2024). Knives are the most used weapon in sexual homicides, and whether a weapon is brought to the scene or obtained opportunistically can provide insight into the offender's level of planning (Beauregard and Martineau, 2012; Keppel and Walter, 1999). Overkill is commonly seen in offenses committed by individuals who are known to the victim (Last and Fritzon, 2005; Higgs *et al.*, 2017). However, exceptions can occur, particularly when victims resist during outdoor incidents (Beauregard *et al.*, 2007; Chopin and Beauregard, 2019).

Based on the literature, we selected 12 variables to analyze the victim-offender relationship:

1. the offender specifically targeted the victim (meaning they had a particular person in mind for the offense instead of selecting them based on opportunity or availability);

2. the victim was approached using deception;
3. the offender brought a weapon;
4. the weapon was a contact or personal weapon;
5. the weapon was a knife;
6. the offender used physical restraint;
7. the offender inflicted overkill (i.e. caused more injury than necessary to kill the victim; [Chopin and Beauregard, 2021](#), p. 47);
8. the victim performed fellatio on the offender;
9. the offender engaged in multiple sexual acts;
10. the offender moved the victim's body;
11. the offender attempted to conceal the body; and
12. items were taken from the crime scene.

A dichotomous variable was chosen to represent the number of sexual acts, as this number can vary based on the offender's time spent with the victim and their level of control. While investigators may not be able to determine the exact number of acts, knowing that an increase in sexual acts correlates with a sadistic typology can inform their approach, similar to the concept of overkill ([Keppel and Walter, 1999](#); [Chopin and Beauregard, 2020](#)). Although the degree of overkill may differ, its presence is an indicator of the victim-offender relationship ([Last and Fritzon, 2005](#)).

### ***Analytical strategy***

A two-step analytical approach was used in this study and conducted using SPSS version 30.0. The two-step approach was chosen for its interpretability, ease of replication by crime analysts using local data, and practical relevance to investigative decision-making.

First, chi-squared tests assessed the prevalence of various behaviors and victim characteristics in sexual homicides involving adult victims (see [Table 1](#)). The goal was to identify relationships between the dependent variable – whether the offender was a stranger to the victim (1 = yes, 0 = no) – and the independent variables based on the crime location. In the second stage, three separate binomial logistic regression models were created including only variables that had a statistically significant association ( $p < 0.05$ ) from the earlier bivariate (chi-squared) analysis as recommended by [Hosmer et al. \(2013\)](#). If a relationship was found in any one of the groups (all cases, indoor only, outdoor only), it would be included in the next stage of the analysis. Only variables with a minimum of five occurrences across all three samples (overall, outdoor and indoor) were retained to ensure stable estimates. There were no multicollinearity concerns, with tolerance values over 0.2 and VIF below five ([Garson, 2016](#)). Finally, the performance of the binary classification models was evaluated using receiver operating characteristic (ROC) curves for all three models.

### **Results**

[Table 1](#) summarizes the bivariate analysis of all sexual homicide cases, comparing outdoor versus indoor offenders in relation to victim and offender behaviors. Based on the chi-squared analysis of all cases, victims with vulnerabilities (substance or psychological disorders) [ $\chi^2(1) = 9.64, p = 0.002, \phi = 0.15$ ], those who appeared to have been targeted [ $\chi^2(1) = 18.72, p < 0.001, \phi = 0.21$ ], and victims who suffered injuries from overkill [ $\chi^2(1) = 14.94, p < 0.001, \phi = 0.18$ ], were more frequently found in cases where the offender

**Table 1** Bivariate analysis by crime scene locations: comparing known offenders and strangers to the victim (*n* = 440)

Variable	All cases ( <i>n</i> = 440)			Outdoor crime scene ( <i>n</i> = 151)			Indoor crime scene ( <i>n</i> = 289)		
	Known ( <i>n</i> = 237)	Stranger ( <i>n</i> = 203)	Phi	Known ( <i>n</i> = 83)	Stranger ( <i>n</i> = 68)	Phi	Known ( <i>n</i> = 154)	Stranger ( <i>n</i> = 135)	Phi
<i>Victim characteristics</i>									
Victim is female	83.5% (198)	87.7% (178)	0.06	85.5% (71)	89.7% (61)	0.06	82.5% (127)	86.7% (117)	0.06
Victim lived alone	16.5% (39)	22.7% (46)	0.08	14.5% (12)	22.1% (15)	0.1	17.5% (27)	23% (31)	0.07
Victim has vulnerable background	41.8% (99)	27.6% (56)	0.15**	41% (34)	29.4% (20)	0.12	42.2% (65)	26.7% (36)	0.16**
<i>Crime behaviors</i>									
Victim targeted	39.2% (93)	20.2% (41)	0.21***	43.4% (36)	16.2% (11)	0.29***	37% (57)	22.2% (30)	0.16**
Approach victim using a con	54% (128)	49.8% (101)	0.04	63.9% (53)	55.9% (38)	0.08	48.7% (75)	46.7% (63)	0.02
Offender brought a weapon	26.6% (63)	46.3% (94)	0.21***	28.9% (24)	51.5% (35)	0.23**	25.3% (39)	43.7% (59)	0.19**
Contact/personal weapon	46.8% (111)	53.2% (108)	0.06	47% (39)	47.1% (32)	0	46.8% (72)	56.3% (76)	0.1
Edged weapon	30% (71)	40.4% (82)	0.11*	22.9% (19)	42.6% (29)	0.21**	33.8% (52)	39.3% (53)	0.06
Physical restraint was used	19.4% (46)	15.8% (32)	0.05	25.3% (21)	4.4% (3)	0.28***	16.2% (25)	21.5% (29)	0.07
Overkill	29.1% (69)	13.8% (28)	0.18***	26.5% (22)	17.6% (12)	0.11	30.5% (47)	11.9% (16)	0.23***
Fellatio	8% (19)	20.7% (42)	0.18***	6% (5)	23.5% (16)	0.25**	9.1% (14)	19.3% (26)	0.15*
Multiple sexual acts	38.4% (91)	53.2% (108)	0.15**	38.6% (32)	54.4% (37)	0.16	38.3% (59)	52.6% (71)	0.14*
<i>Post crime behaviors</i>									
Body moved	32.1% (76)	21.2% (43)	0.12**	31.3% (26)	25% (17)	0.07	32.5% (50)	19.3% (26)	0.15*
Attempt to conceal body	32.5% (77)	28.6% (58)	0.04	31.3% (26)	26.5% (18)	0.05	33.1% (51)	29.6% (40)	0.04
Items taken	31.6% (75)	52.7% (107)	0.21***	32.5% (27)	41.2% (28)	0.09	31.2% (48)	58.5% (79)	0.28***

Note(s): \* *p* < 0.05; \*\* *p* < 0.01; \*\*\* *p* < 0.001

Source(s): Authors' own work

was known to the victim. In contrast, strangers more often brought a weapon [ $\chi^2(1) = 18.53$ ,  $p < 0.001$ ,  $\phi = 0.21$ ], used a knife [ $\chi^2(1) = 5.25$ ,  $p = 0.022$ ,  $\phi = 0.11$ ], had the victim perform fellatio [ $\chi^2(1) = 14.71$ ,  $p < 0.001$ ,  $\phi = 0.18$ ], engaged in multiple sexual acts [ $\chi^2(1) = 9.68$ ,  $p = 0.002$ ,  $\phi = 0.15$ ], and took items from the scene [ $\chi^2(1) = 20$ ,  $p < 0.001$ ,  $\phi = 0.21$ ].

## Outdoors

The analysis of outdoor crimes ( $n = 151$ ) revealed five significant variables. Offenders who were acquainted with their victims more frequently specifically targeted them [ $\chi^2(1) = 12.9$ ,  $p < 0.001$ ,  $\phi = 0.29$ ] and used physical restraints [ $\chi^2(1) = 12.2$ ,  $p < 0.001$ ,  $\phi = 0.28$ ]. In contrast, strangers more often brought a weapon [ $\chi^2(1) = 7.99$ ,  $p = 0.005$ ,  $\phi = 0.23$ ], used a knife [ $\chi^2(1) = 6.73$ ,  $p = 0.009$ ,  $\phi = 0.21$ ] and had the victim perform fellatio [ $\chi^2(1) = 9.57$ ,  $p = 0.002$ ,  $\phi = 0.25$ ].

## Indoors

When the crime occurred indoors ( $n = 289$ ), eight variables were associated with the victim-offender relationship. Offenders acquainted with their victims more often selected victims with vulnerabilities (substance or psychological disorders) [ $\chi^2(1) = 7.64$ ,  $p = 0.006$ ,  $\phi = 0.16$ ], specifically targeted the victim [ $\chi^2(1) = 7.48$ ,  $p = 0.006$ ,  $\phi = 0.16$ ], engaged in overkill [ $\chi^2(1) = 14.71$ ,  $p < 0.001$ ,  $\phi = 0.23$ ] and moved the victim's body after the crime [ $\chi^2(1) = 6.48$ ,  $p = 0.011$ ,  $\phi = 0.15$ ]. In contrast, strangers more frequently brought a weapon [ $\chi^2(1) = 10.84$ ,  $p < 0.001$ ,  $\phi = 0.19$ ], had the victim perform fellatio [ $\chi^2(1) = 6.24$ ,  $p = 0.013$ ,  $\phi = 0.15$ ], engaged in multiple sexual acts [ $\chi^2(1) = 5.93$ ,  $p = 0.015$ ,  $\phi = 0.14$ ], and took items from the crime scene [ $\chi^2(1) = 21.84$ ,  $p < 0.001$ ,  $\phi = 0.28$ ].

Based on the bivariate analysis, the eight statistically significant variables were chosen for the logistic regression models. The stratified binomial regression models for indoor and outdoor settings showed good fit, supported by nonsignificant Hosmer and Lemeshow tests (Outdoor:  $p = 0.712$ ; Indoor:  $p = 0.26$ ). However, the full model (Model 1) for all sexual homicides did not pass the Hosmer and Lemeshow test ( $p < 0.001$ ). When six outlier cases were removed, the model passed the Hosmer and Lemeshow test ( $p = 0.161$ ); however, the overall model significance and substantive conclusions remained unchanged [ $\chi^2(8) = 125.4$ ,  $p < 0.001$ ]. Because exclusion of the outliers did not meaningfully alter the results and the outliers reflect the variation in actual cases, they were retained in the final analysis.

Model 1 (all cases) was statistically significant [ $\chi^2(8) = 103.57$ ,  $p < 0.001$ ] with a Nagelkerke  $R^2$  of 0.28, accurately classifying 73.4% of the cases. The ROC curve was 0.77 (0.77,  $p < 0.001$ , 95% CI [0.72, 0.81]), indicating an acceptable level of discrimination (Hosmer *et al.*, 2013). Among the eight predictors analyzed, six were statistically significant while controlling for other variables (see Table 2). Victims with substance use or psychological disorders were 2.4 times more likely to involve a known offender ( $OR = 0.42$ ,  $p < 0.001$ ). Similarly, victims who were specifically targeted were four times more likely to involve a known offender ( $OR = 0.25$ ,  $p < 0.001$ ), and cases involving overkill were 2.9 times more likely to involve a known offender ( $OR = 0.35$ ,  $p < 0.001$ ). In contrast, offenders who brought a weapon to the crime scene were 2.4 times more likely to be strangers to their victims ( $OR = 2.40$ ,  $p = 0.001$ ). In addition, stranger offenders were 2.7 times more likely to have the victim perform fellatio ( $OR = 2.67$ ,  $p = 0.003$ ), and were more than twice as likely to take items from the crime scene ( $OR = 2.22$ ,  $p < 0.001$ ), compared to offenders who were known to the victim.

Model 2, which was limited to sexual homicides that occurred outdoors, was also statistically significant [ $\chi^2(8) = 38.50$ ,  $p < 0.001$ ] with a Nagelkerke  $R^2$  of 0.30, accurately classifying 72.90% of cases and an area under the ROC curve that was statistically significant at 0.76 (0.76,  $p < 0.001$ , 95% CI [0.68, 0.84]) (Hosmer *et al.*, 2013). After

**Table 2** Logistic regression predicting offender–victim relationship by crime location for adult victims (*n* = 440)

Variables (1 = yes)	All cases ( <i>n</i> = 440)				Outdoor crime scene ( <i>n</i> = 151)				Indoor crime scene ( <i>n</i> = 289)			
	B (SE)	OR	LL	UL	B (SE)	OR	LL	UL	B (SE)	OR	LL	UL
Victim has vulnerable background	-0.88 (0.24)	0.42***	0.26	0.67	-0.85 (0.42)	0.43*	0.19	0.97	-0.84 (0.30)	0.43**	0.24	0.78
Victim targeted	-1.39 (0.25)	0.25***	0.15	0.41	-1.86 (0.47)	0.16***	0.06	0.39	-1.13 (0.31)	0.32***	0.18	0.59
Offender brought a weapon	0.88 (0.25)	2.40***	1.47	3.94	0.81 (0.42)	2.25	0.99	5.15	0.89 (0.32)	2.44**	1.30	4.61
Edged weapon	-0.08 (0.26)	0.92	0.56	1.52	0.19 (0.45)	1.21	0.50	2.92	-0.26 (0.32)	0.77	0.41	1.45
Fellatio	0.98 (0.33)	2.67**	1.40	5.08	1.42 (0.63)	4.14*	1.20	14.21	0.76 (0.40)	2.15	0.98	4.73
Overkill	-1.06 (0.28)	0.35***	0.20	0.60	-0.71 (0.46)	0.49	0.20	1.22	-1.31 (0.36)	0.27***	0.13	0.55
Body moved	-0.48 (0.25)	0.62	0.38	1.01	-0.12 (0.44)	0.89	0.38	2.11	-0.66 (0.31)	0.52*	0.28	0.96
Items taken	0.80 (0.22)	2.22***	1.44	3.41	0.31 (0.39)	1.37	0.63	2.95	1.05 (0.27)	2.85***	1.67	4.86
Constant	0.15 (0.23)	1.16			0.13 (0.39)	1.14			0.14 (0.29)	1.15		
Hosmer and Lemeshow test	<0.001				0.712				0.260			
X <sup>2</sup> (8)	103.57***				38.50***				72.92***			
Nagelkerke R <sup>2</sup>	0.28				0.30				0.30			
Overall % predicted	73.40%				72.80%				72.66%			
ROC-AUC (stranger)	0.77 (0.02) ***		0.72	0.82	0.76 (0.04) ***		0.68	0.84	0.77 (0.03) ***		0.71	0.83

Note(s): \* *p* < 0.05; \*\* *p* < 0.01; \*\*\* *p* < 0.001

Source(s): Authors' own work

controlling for other variables in the model, three predictors remained statistically significant (see Table 2). Victims with substance or psychological disorders were 2.3 times more likely to be murdered by a known offender ( $OR=0.43$ ,  $p=0.042$ ). Similarly, offenders who targeted a specific victim outdoors were 6.3 times more likely to be known ( $OR=0.16$ ,  $p<0.001$ ), while those who had the victim perform fellatio were more than four times more likely to be a stranger ( $OR=4.14$ ,  $p=0.024$ ). However, among outdoor sexual homicides, use of an edged weapon ( $p=0.054$ ), presence of overkill ( $p=0.125$ ) and whether the offender removed items from the scene ( $p=0.428$ ) were not statistically significant predictors of the victim-offender relationship.

Model 3, which included only indoor sexual homicides, was significant [ $\chi^2(8)=72.92$ ,  $p<0.001$ ], with a Nagelkerke  $R^2$  of 0.30, accurately classifying 72.66% of the cases. The area under the ROC curve was significant at 0.77 (0.77,  $p<0.001$ , 95% CI [0.72, 0.83]). After controlling for other variables in the model, six predictors were statistically significant (see Table 2). Victims with substance use or psychological disorders were 2.3 times more likely to be killed by a known offender ( $OR=0.43$ ,  $p=0.005$ ). Similarly, cases in which the victim was specifically targeted were three times more likely to involve a known offender ( $OR=0.32$ ,  $p<0.001$ ). Cases involving overkill ( $OR=0.27$ ,  $p<0.001$ ) or where the victim's body was relocated ( $OR=0.52$ ,  $p=0.036$ ) were more likely to involve a known offender. In contrast, when the sexual homicide occurred indoors, strangers were 2.4 times more likely to bring a weapon ( $OR=2.44$ ,  $p=0.006$ ) and 2.9 times more likely to take items from the scene ( $OR=2.85$ ,  $p<0.001$ ) compared to those known to the victim.

## Discussion

Law enforcement relies on a range of behavioral indicators, beyond crime location, to assess the relationship between the victim and the offender. Rather than treating crime location as a standalone predictor, this study examined whether commonly used behavioral indicators predicted the victim-offender relationship differently depending on whether the crime occurred indoors or outdoors. By first analyzing all cases together, and then separating them by crime scene location, the study assessed whether investigators should interpret behaviors the same way in indoor and outdoor sexual homicides. The findings suggest that the importance of several behaviors changes once crime scene context is considered.

### All cases: stranger offender compared to offenders known to the victim

When cases were analyzed collectively, the results supported earlier findings showing that certain behaviors predict the victim-offender relationship when indoor and outdoor cases are combined. Across all cases, stranger offenders are more likely to carry a weapon, have the victim perform fellatio, or remove items from the crime scene. In contrast, cases involving offenders known to the victim were more likely to involve targeted victims, evidence of overkill and victims with known substance use or mental health challenges.

Prior research suggests that stranger offenders tend to be more goal-oriented than emotionally driven, and often target vulnerable individuals, particularly in outdoor settings (Adjorlolo and Chan, 2017; Chan, 2024; Higgs *et al.*, 2017). These offences commonly involve behaviors reflecting manipulation, control and humiliation of the victims, such as having the victim perform fellatio, and the removal of items from the crime scene (Beauregard and Proulx, 2002; Dietz *et al.*, 1990; Kim *et al.*, 2024; Meloy, 2000). While the murder is not always fully planned, stranger offenders are more likely to approach the crime with sexual intent and some degree of preparation (Adjorlolo and Chan, 2017; Beech *et al.*, 2005; Chan, 2024; Kim *et al.*, 2024).

## Outdoor sexual homicides

When we separated the cases by indoor versus outdoor crime scenes, the predictive power of certain behaviors changed. In outdoor homicides only three out of the eight behaviors significantly predicted whether the offender was known to the victim (see Figure 1). Specifically, known offenders were more likely to (1) target a specific individual and (2) select victims with a history of substance use or mental health challenges. In contrast, the only behavior associated with stranger offenders was when they had the victim perform fellatio.

However, other behaviors commonly associated with stranger offenders in previous research, such as bringing a weapon to the scene or taking items from it (Kim *et al.*, 2024) or overkill, a behavior tied to emotional responses in personal relationships (Douglas *et al.*, 2006; Gerard *et al.*, 2007; Last and Fritzon, 2005), did not predict the victim-offender relationship in outdoor cases. The departure from earlier findings may reflect the unpredictable and less controlled nature of outdoor crime scenes. Contextual pressures, such as the threat of being seen, the need to act quickly, or the victim's resistance, may override typical behavioral patterns (see Ceccato, 2014; MacCulloch *et al.*, 1983). In some cases, these dynamics may reflect the expression of sadistic themes described in prior research, which link humiliation and control to opportunistic forms of violence (Chopin and Beauregard, 2019). In addition, Skrudland and colleagues (2025) found that overkill, was associated to lower-risk offending (i.e. the frequency of selecting crime locations with the risk of witness detection) and suggested that in some cases, overkill may serve a rational purpose for organized, sadistic offenders, by obscuring the victim's identity in an attempt to avoid detection (Chopin and Beauregard, 2021).

*Known offender:* Outdoor sexual homicides committed by known offenders are more likely to involve victims who have been specifically targeted, particularly individuals with recognized vulnerabilities such as substance abuse or mental health challenges. Prior research shows that substance use is often present in sexual homicides fueled by anger or

**Figure 1** Comparison of behaviors that are more or less likely based on crime scene and offender relationship

Variables (1 = yes)	All Cases (n = 440)		Outdoor Crime Scene (n = 151)		Indoor Crime Scene (n = 289)	
	Stranger (n = 203)	Known (n = 237)	Stranger (n = 68)	Known (n = 83)	Stranger (n = 135)	Known (n = 154)
Victim has vulnerable background	-	+	-	+	-	+
Victim targeted	-	+	-	+	-	+
Offender brought a weapon	+	-			+	-
Edged weapon						
Fellatio	+	-	+	-		
Overkill	-	+			-	+
Body moved					-	+
Items taken	+	-			+	-

Note: Shading reflects the relative size of the odds ratios within each model. As a general guide, odds ratios of approximately 1.5 or lower were regarded as weak, values around 2.5 as moderate, and values of 4.0 or higher as strong (Maher *et al.*, 2013).  
 (+) Behavior is more likely in this group  
 (-) Behavior is less likely in this group  
 Color shading (applied across each row):

- Dark blue = Large odds ratio
- Medium blue = Moderate odds ratio
- Light blue = Small odds ratio
- Grey = Not statistically significant

Source: Authors own work

resentment, where the offender – typically someone familiar to the victim – reacts violently to something the victim.

Because known offenders have prior knowledge of the victim's routines and vulnerabilities, they may place themselves in situations that allow them to act when the victim is most vulnerable (Beauregard *et al.*, 2007; Kim *et al.*, 2024). This familiarity provides strategic advantages, including the ability to assess risk, anticipate resistance and create opportunities for isolation that are not available to strangers (Rossmo, 2025). For example, Schlesinger (2007) describes a case in which a woman's ex-husband, aware of her Christmas Eve routine, waited for her to return from midnight mass and attacked her before she reached the safety of her home (p. 247).

*Stranger offenders:* In outdoor settings, only cases where the offender had the victim perform fellatio predicted a stranger offender. Other behaviors typically associated with stranger offenders, such as bringing a weapon or taking items from the scene, did not differentiate them when the homicide occurred outdoor. While these offenders may have involved the victim in the crime by having them perform a sexual act, they were no more likely than known offenders to carry weapons, suggesting a level of psychological control over the victim (see discussion in Rossouw *et al.*, 2024). Studies show that sadistic fantasies often center on themes of humiliation and control (Beauregard and Proulx, 2002; Meloy, 2000), which may be enacted through such behavior.

In outdoor settings, since weapons are not always available, offenders may arrive prepared to maintain control, regardless of their relationship to the victim (Beauregard *et al.*, 2007). Although previous research has shown that stranger offenders, often classified as sadistic, are more likely to take items from crime scenes (Higgs *et al.*, 2017; Keppel and Walter, 1999; Kim *et al.*, 2024), this behavior did not predict victim-offender relationship in outdoor cases. In such environments, removing items may function as a forensic awareness strategy for both stranger and nonstranger offenders (Salfati and Canter, 1999), rather than as thefts typical of residential sexual assaults committed by strangers (Warr, 1988).

### Indoors sexual homicides

Offenders who commit sexual homicides indoors display a wider range of behaviors than those who offend outdoors. In this study, six out of eight behavioral variables were found to be significant predictors of the victim-offender relationship in indoor crimes. Notably, the act of moving the victim's body was a predictor of a known offender indoors, whereas this behavior did not show predictive value in combined or outdoor analyses. By contrast, fellatio did not predict the victim-offender relationship when the crime occurred indoors.

*Known offender:* When sexual homicides occur indoors, victims are more likely to know their attacker when the victim is specifically targeted, have known vulnerabilities (such as substance use or mental health issues), their body is moved after the crime, or there are signs of overkill. These findings are consistent with prior research, which shows that female victims who have consumed substances before the crime, are more frequently attacked by someone with whom they have had prior interactions (Beauregard *et al.*, 2008).

Offenders who are acquainted with their victims also tend to select the victim's residence (21.8%), their own home (19.3%) or at a third party's location (17.6%) to commit a sexual assault (Lovell *et al.*, 2016). Their connection to the indoor crime scene may help explain why they are more likely to relocate the victim's body after the crime, compared to strangers in cases of indoor sexual homicides (Salfati and Canter, 1999). Relocating the victim's body can be a tactic used to delay its discovery or to distance the offender from the crime scene (Reale and Beauregard, 2018).

*Stranger offenders:* When sexual homicides occurred indoors, stranger offenders in the current study were less likely to move the victim's body but they were more likely to bring a weapon and remove items from the indoor crime scene. Indoor sexual assaults have been described as "hybrid offenses," in that the same characteristics that make a home appealing for burglary, such as easy access and low visibility, also increase the risk of sexual offenses (Warr, 1988, p. 275).

While the privacy of a home can reduce the likelihood of interruptions and offer greater potential rewards, it also presents challenges for offenders unfamiliar with the victim or their environment (Ceccato, 2014; Rossmo, 2025; Warr, 1988). A victim's residence, for example, may offer privacy, but it also carries uncertainties, such as limited escape routes, the risk of attracting the attention of neighbors, or someone unexpectedly returning home (Rossmo, 2025, p. 171). As time spent at the scene increases, so does the risk of detection, with risk rising as offenders move from public (i.e. the street) into increasingly private spaces (Rossmo, 2025, pp. 170–171). From this perspective, one possible explanation for why fellatio did not predict a stranger offender in indoor cases is that offenders may adjust their behavior based on the constraints and opportunities of the setting. Prior research indicates that some offenders may instead express dominance through verbal or physical control or may be aroused by the risk associated with being inside the victim's home (Higgins *et al.*, 2017; MacCulloch *et al.*, 1983).

### Limitations

Several limitations should be considered when interpreting these findings. First, the analysis was limited to solved cases. As Quinet and Nunn (2014) note, solved homicides may differ in meaningful ways from unsolved ones, particularly in the availability of behavioral evidence or witness information (see also Minkler *et al.*, 2024). This may influence which behaviors are observed and recorded. In addition, case information is drawn from police records and coded by trained crime analysts, and practices for collecting and documenting information can change over time. Therefore, classification mistakes, reporting inconsistencies or missing information can occur. Although this distinction could not be examined in the current study, prior research suggests that offending dynamics may vary by the offender–victim relationship. Offenses involving intimate partners, family members or friends can differ from those involving acquaintances, and patterns may also differ when offenders target adult males versus adult females (see Chan and Myers, 2025). These distinctions warrant further study and consideration in future research.

Second, although the study assessed a range of crime scene behaviors, some – such as staging – occurred too infrequently to be included in statistical models. Despite their potential relevance to understanding the offender's relationship to the victim (Douglas *et al.*, 2006), rare behaviors are often omitted from analysis, which may limit our understanding of atypical but meaningful patterns.

Third, the study was restricted to adult victims (aged 16–65) who were not engaged in sex work. While this allowed for greater consistency across cases, it also limits generalizability. Future studies should examine how behavioral predictors vary across other victim groups, including children, elderly individuals or those classified as high-risk. These groups may involve different dynamics in victim selection, access and offender planning.

Finally, future work should consider whether offender typologies—such as sadistic or opportunistic sexual homicide—show stable behavioral patterns across different environments, or whether certain behaviors only emerge under specific situational constraints. Future research would also benefit from using alternative analytical approaches, such as conjunctive analysis, to examine how combinations of behaviors jointly characterize offending patterns among stranger offenders and different types of known offenders. Research that also explores how behavioral assumptions contribute to

investigative errors or wrongful arrests could further strengthen the practical application of crime-scene analysis.

## Practical implications

Despite these limitations, the study provides several practical and theoretical contributions. Most notably, it represents an initial step in suggesting that crime scene location, whether a sexual homicide occurs indoors or outdoors, can shape which behaviors are most useful for predicting whether the offender was known to the victim. The finding is particularly relevant in outdoor settings, which tend to be more difficult to investigate and resolve (Bichler *et al.*, 2017; Davis *et al.*, 2014) and suggests that commonly used behavioral indicators may require careful interpretation and further examination when applied across different crime scene contexts.

Previous studies have shown that offender behavior is shaped by situational constraints, preferences, and opportunities (Chopin and Beauregard, 2021; Chopin *et al.*, 2020; Cornish and Clarke, 1986, 2018; Eck and Weisburd, 2015; MacCulloch *et al.*, 1983; Meloy, 2000). As Minkler and colleagues (2025) remind us, the behaviors we study are shaped not only by offending decisions but also by which cases are ultimately solved. In this context, separating cases by location revealed that several behaviors commonly associated with known or stranger offenders did not carry the same predictive value in outdoor environments, or were only relevant in indoor cases (i.e. moving the victim's body). Still, it would have otherwise been insignificant if considered among all the instances (indoor and outdoor). This aligns with past research highlighting how the nature of public versus private space alters offender decision-making and crime scene dynamics (Ceccato, 2014; Rossmo, 2025; Warr, 1988).

For investigators, these results suggest there is value in examining behavioral details in the context of the crime location (Douglas *et al.*, 2006). As noted by Detective Reichert, outdoor homicides that appear to involve a stranger are particularly daunting for investigators (Bichler *et al.*, 2017). Cases that occur outside, particularly when no witnesses or physical evidence are present, require additional care in evaluating behavioral indicators. Typologies or checklists created without considering the crime location may be less effective if they assume that all behaviors have the same significance across different contexts (e.g. Beauregard and Chopin, 2025; Kim *et al.*, 2024; Meloy, 2000; Schlesinger, 2007). A behavior such as oral sex, though sometimes overlooked or underreported because it is not easily observable, can provide valuable insights when considered in relation to the location of the offense (Pagaling Hagan, 2017, p. 465). For instance, oral sex was found to predict stranger-perpetrated homicide in outdoor settings but not indoors. If investigators are unaware that certain behaviors hold predictive value only in specific contexts, they may overlook important early leads about the nature of the offender–victim relationship.

Theoretically, this study supports a situational approach to understanding offender behavior. It also lends support to the rational choice perspective, which emphasizes that decisions are shaped by context, perceived risk and opportunity. While the current sample was modest, particularly in the outdoor subgroup, these findings point to the value of future studies that assess behavioral indicators separately by setting. By doing so, both research and practice may improve their ability to interpret the meaning of crime scene behaviors and better inform investigative strategies (Davies *et al.*, 2018).

## Conclusion

Prior research has shown that sexual homicides committed indoors more often involve offenders known to the victim, whereas strangers more commonly associated with those that occur outdoors (Chan, 2024). As Rossmo (2025) cautions, however, statistical

patterns only gain meaning when placed in a proper context (p. 23). This study addresses an important gap in the literature by examining whether behavioral predictors of the victim–offender relationship should be interpreted the same way in indoor and outdoor sexual homicides. Although this study represents an initial step, the findings suggest that the significance of these behaviors does change when crime scene context is considered.

These results build on prior research showing that situational context plays a key role in shaping offender behavior in sexual homicides (Chopin and Beauregard, 2021; Kim *et al.*, 2024; Rossouw *et al.*, 2024). Overall, the findings highlight the importance of incorporating crime scene location into research and assessment of behavioral indicators of the victim–offender relationship. Doing so may improve the accuracy of early investigative judgments and reduce the risk of misinterpretation when inferring the victim–offender relationship.

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