

Psychological contributions to cold case investigations: A systematic review

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ABSTRACT

This article presents a systematic review of the available literature on 'what works' in cold case investigations, with a specific focus on psychological evidence-based research. Long-term unsolved and cold cases present their own unique set of challenges, such as lack of hard evidence, recall accuracy, and witness credibility. Therefore, this review provides a collated base of research regarding preventative methods and investigative tools and techniques developed to highlight gaps in the literature and inform best practice in cold case investigations. The review features victim and crime characteristics that may contribute to a case becoming cold and displays contributing factors to cold case clearance. Although promising, at present, psychological research in this field is insufficient to inform evidence-based guidance. Future research should aim to explore the wider psychological and criminal justice-based literature (e.g., memory retrieval and cognitive bias) to investigate what could be applicable to cold case investigations.

1. Introduction

Over the past couple of decades, there has been an increasing fascination with cold cases in popular culture. We see this in the emergence of true crime podcasts, documentaries, best-selling books, and even CrimeCon, an annual convention for true crime fans hosted in various countries [75]. Although we are generally more aware of these types of cases, currently there is no clear, universal definition of a 'cold case' [2, 18]. In the UK, a 'long-term case' is defined as one that is open for twenty-eight days or longer [24]. Whereas a 'cold' case is often used to describe a case which has not been cleared by arrest or prosecution [14]; however, there is no specified point in time whereby an unsolved long-term case becomes a cold case. With this in mind, it is generally recognized that a case becomes cold when it is deemed that no further progress can be made (i.e., when all viable leads have been exhausted [16]). This effectively recategorizes the case from a long-term active to a long-term inactive, or cold, case.

It is difficult to estimate the number of cases that are unsolved, and thus deemed cold. However, this figure is likely to be substantial. For example, in the United States, The Murder Accountability Project reports 34% (roughly 331,000) of homicides reported between 1965 and 2020 as unsolved [67]. Similarly, in England and Wales, 33% of all initially recorded homicides between April 2018 and March 2019 saw no suspects charged [44]. These figures demonstrate a high proportion of homicide cases likely to go cold. However, in the whole category of cold cases there is a breadth of other crimes that must be considered.

Research has ascertained that long-term missing person inquiries are

an important contributor to cold cases [9,78]. In fact, it is estimated that in the United Kingdom there are over 5000 unsolved missing person cases over one year old and over 1000 unidentified body cases [58,65]. In addition, although sexual assault is one of the most common violent offenses [21], it is also one of the most underreported and most difficult to prosecute [15], leading to many reported cases remaining unsolved and more recently, an influx of delayed allegations. Most recent figures from the Home Office and the Ministry of Justice show a decline in the rate of resolution for these cases, with less than 2% of rape cases resulting in suspects being summonsed or charged [12]. Thus, although we are unable to provide a singular number that defines how many long-term and cold cases exist, it is evident that these cases form a large proportion of police investigations.

Compared to current and active investigations, cold cases present a unique set of challenges to investigators. New investigative leads are needed, but they are often time-critical and become more difficult to find as time passes [3]. Research has suggested that the framing of a cold case as being one that is difficult, if not impossible, to solve, can create a cognitive response in investigators based on pessimism [74]. This mindset can in turn have a detrimental impact on the motivation and effort to continue searching for more leads, resulting in unfruitful outcomes. Exacerbating this further, many police forces are under-resourced due to budget cuts, meaning that cases are prioritized according to their likelihood of resolution, with cold cases naturally scoring lower on such prioritization matrices [31,57,89].

In many criminal investigations, witness accounts play a central role in informing the police about what happened and who was involved

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[37]. It is therefore important to obtain reliable information promptly, that is sufficiently detailed, to develop investigative lines of enquiry that ultimately help find, arrest, and bring perpetrators to justice. Psychological research has shown that the quality of witness accounts is time-critical [45]. As the delay increases, so too does the likelihood of forgetting, meaning that potentially critical leads from witnesses become less available over time. The passing of time can also pose a serious threat to recall accuracy, as there is greater opportunity for a witness's memory to be contaminated by inaccurate information encountered between the time of the event and the time of providing an account to the police [32,59]. Exposure to post-event information from co-witnesses, friends, family, local or national news, and social media, can also negatively influence a witness's original memory for what happened and who was involved [36]. Furthermore, research has shown that greater emotion can increase people's susceptibility to false memories [49], suggesting that memory recall could be especially at risk of contamination from the loved ones of a cold case victim. In sum, a sizable challenge for cold-case investigators is their ability to obtain a reliable account from witnesses about a crime that happened in the past.

Although there are important obstacles to consider in cold case investigations, advances in forensic science have helped develop new methods, tools, and techniques to aid the investigation process. For example, the introduction of DNA testing was a turning point in criminal investigations, enabling suspects to be identified from biological traces such as blood, saliva, and hair [50]. More recently, genetic genealogy, using direct-to-consumer genetic testing companies such as 23andMe or AncestryDNA, has been successfully used to infer genetic relationships in both active and cold cases [40]. In recent years, psychological research has also been central to informing policy and procedures surrounding effective evidence gathering techniques such as investigative interviewing [62] and identification procedures [88]. In the context of investigative interviewing, this has led to the development of scientifically informed training and practice of core skills such as rapport building, retrieval facilitation techniques, and the use of effective questions [26,38,63,85]. For example, the UK based College of Policing has a 'What Works Centre for Crime Reduction' that collects and shares research evidence on crime reduction and supports its use in practice [25]. In short, psychological research has, and continues to, support evidence-based practice within many areas of criminal investigations. However, the current body of knowledge is yet to be collated to inform and support cold case investigations.

To understand how psychology can best contribute to the investigation of cold cases, it is imperative to start by reviewing the literature and identifying relevant empirical research. In the last few years, greater attention has been paid to how we can bridge the gap between police working on cold cases and academics researching ways to assist investigations [52], however we still know relatively little. Therefore, this article presents a systematic review of the available literature on 'what works' in cold case investigations, with a specific focus on psychological evidence-based research. This review is both practical and timely given the rise in the number of cold cases (34% of reported homicides between 1980 and 2000 compared to 43% of reported homicides between 2000 and 2021 [67]), and the associated challenges with cold case investigations. Furthermore, it is the first to collate, synthesize and evaluate the findings of empirical research regarding methods, investigative tools and techniques developed to prevent, solve, and inform best practice in cold case investigations.

2. Methodology

2.1. Search strategy

In January 2022, three academic databases (EThOS: e-thesis online service, PsycInfo, Web of Science) were searched to identify studies that reported on preventative methods, and investigative tools and techniques relevant to cold case investigations. The following Boolean

search string was used, where all words must appear in the abstract: ("cold case*" OR "unsolved case*" OR "long-term case*" OR "long-term unsolved") AND ("investigat*" OR "police" OR "law enforcement"). Upon finding no results in our EThOS search, we decided to exclude non-peer reviewed papers. In addition, we conducted a manual search of papers' bibliographies relevant to the topic.

2.2. Criteria for inclusion and exclusion of studies

Studies were included if they examined psychologically informed preventative methods, investigative tools and/or techniques intended to prevent or improve the efficacy of cold case or long-term investigations. Both quantitative and qualitative research was included. Studies were excluded if they: (1) did not focus on cold case or long-term investigations; (2) did not come from within the field of psychology (e.g., forensic science); (3) did not include an evaluation of preventative methods, or investigative tools or techniques, and; (4) were written in languages other than English. Finally, we excluded reviews, non-peer reviewed papers, and non-empirical books and book chapters.

2.3. Search results

Our initial search yielded 265 results (this included 263 results from our chosen databases and two results from manual searching, no grey literature was found). Duplicates were then removed, leaving 250 articles for title and abstract screening. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow chart outlines the steps we followed throughout the screening process, including the number of articles we found, included, excluded and common reasons for exclusion (see Fig. 1).

2.4. Screening and study selection

Screening is the practice of determining eligibility by reviewing the initially identified studies against the inclusion and exclusion criteria. We used a two-step screening process that comprised: (1) title and abstract screening, and (2) full-text review. During the first step, titles that had no relevance to cold case or long-term investigations were eliminated. Abstracts were also inspected to determine whether each study reported on preventative methods, tools, and/or techniques, were psychologically informed, and were evaluated for use in cold case investigations. Studies that did not meet these criteria were removed. Studies that passed the title and abstract screening, or were deemed unclear at this stage (e.g., due to insufficient information presented in the abstract), were included in the second step of the screening process.

During the second step, articles were determined to be ineligible if the study did not investigate specific preventative methods, or investigative tools or techniques, it was not psychologically informed, and/or it did not evaluate the methods, tools, or techniques for use in cold case investigations. Twelve articles passed the second step of the screening process and were reviewed to determine their goal or focus (e.g., victim or crime characteristics) and methodological approach.

The first step of the screening process was undertaken by multiple researchers who had all received relevant training. The statistical test Cohen's K was performed to determine the level of agreement between researchers during the abstract screening process, and there was a substantial level of interrater agreement with the given inclusion and exclusion criteria, $K = .681, p < .001$ [61].

3. Results and discussion

Of the twelve studies that met the inclusion criteria, six were

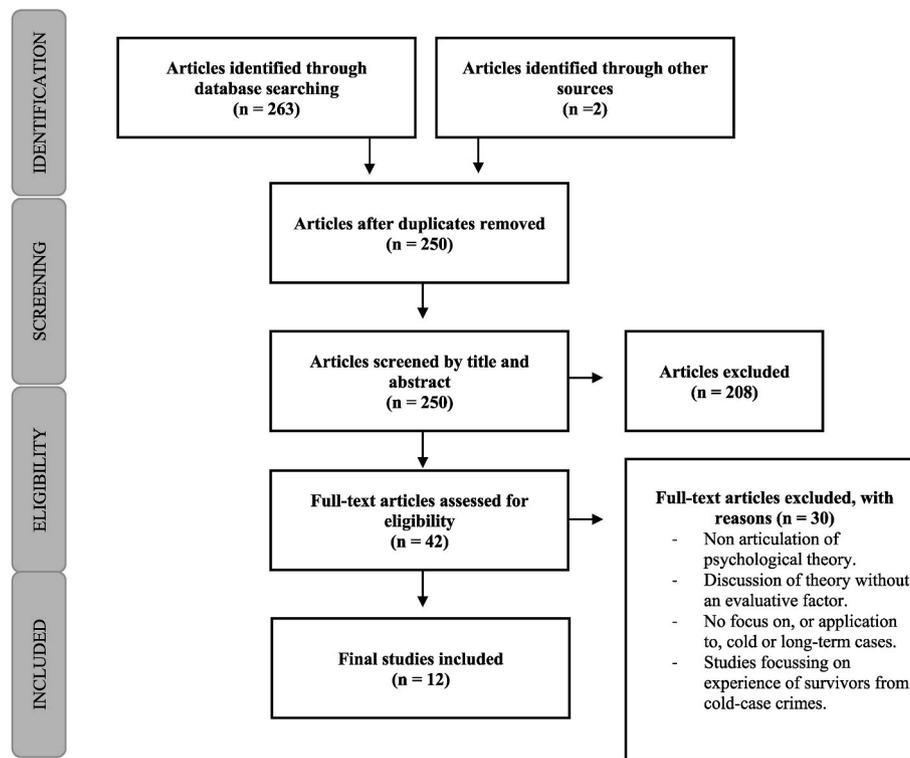


Fig. 1. Prisma flow chart outlining key phases.

quantitative, five were qualitative, and one was mixed methods. Through a thorough review of these studies, we found that two themes of focus emerged: (1) preventative methods,¹ which comprised of six studies (five quantitative and one qualitative), and analyzed crime and victim characteristics in solved and unsolved cases to identify factors that may lead to a case going cold; and (2) investigative tools and techniques, which comprised of six studies (five qualitative and one mixed methods), and explored ‘what works’ in already cold cases.

3.1. Preventative methods

Six studies examined the solvability of cases to better understand the characteristics associated with a case being unsolved and by extension going cold. Articles in this theme examined the crime characteristics to provide insight into the qualities of the perpetrator and offense before, during, and after the crime; and/or the victim characteristics to understand what attributes of a victim are more likely to be associated with unsolved cases. Table 1 summarizes the key features of the studies included within the systematic review categorized as preventative methods. Four studies [17,19–21] examined criminal offenses with a sexual motive (sexual homicide, rape, and other sexual offenses), one focused on contract killings [13] and one [73] investigated general homicide.

3.1.1. Crime characteristics

Crimes can be split into three phases, namely pre-crime, crime, and post-crime. These phases reflect the lead-up to the crime, the crime itself, and the events after the crime, respectively. Given the complexity of the topic, most studies provided insight on more than one of these phases.

With regards to the pre-crime phase, Chopin et al. [21] examined behaviors that rape offenders utilize to avoid police detection and found

¹ In the context of this article, ‘preventative methods’ solely refer to the category of studies that highlight reasons as to why a case may have gone cold.

that the likelihood of a case being solved increased if the victim was initially targeted by the offender and the offender used a ruse or con to approach the victim. In contrast, they found that the case was more likely to remain unsolved when the victim and offender were strangers, and the offender used a surprise attack. Chiu and Leclerc [19] performed a regression and conjunctive analysis to identify predictors of solved and unsolved sexual crimes. They discovered that the offender consuming alcohol or drugs prior to the offense was strongly associated with the solvability of the case. This is presumably due to intoxication often leading to more reckless behavior and less forensic awareness (e.g., leaving more evidence and/or witnesses). Alcohol is known to impair decision-making and can lead to taking more risks [39]. Previous research has indicated that alcohol increases the solvability to a crime due to lower forensic awareness [6]. It is possible that in sexual offenses, alcohol consumption can influence arousal to a sub-optimal level, thereby impairing their forensic awareness [6]. In the context of general homicide, the presence of known pre-crime factors, such as an argument, increases the odds of a case clearance [73]. A lack of understanding of pre-crime circumstances often indicates a lack of information or evidence. An argument before a homicide has taken place would, for example, have given a viable lead for the police to follow in the beginning stages of an investigation.

Proceeding to the crime phase, Chai et al. [17] investigated body disposal patterns in sexual homicide and examined whether offender’s behaviors differ between solved and unsolved cases. Identifying behavioral patterns associated with body disposal can potentially assist police investigators in narrowing down a possible suspect list by providing information about the nature of the crime, an offender’s criminal experience level, and whether there might have been a relationship between the victim and the offender (see also [66]). In this study, the only crime phase variable they found associated with unsolved cases was evidence of stabbing. In other words, a case was more likely to remain unsolved when an offender stabbed their victim in a sexual homicide. Similarly, Regoeczi et al. [73] found that homicides involving a knife were solved less frequently than homicides involving physical violence using one’s own extremities. Previous research has

Table 1
Summary of key points from articles categorized within preventative methods.

Reference	Crime characteristics	Victim characteristics	Design
Brolan et al., 2016 [13]	Evidence of experienced contract killing on victim's doorstep with bullets fired at closed range.	Not applicable	Qualitative
Chai et al., 2021 [17]	Evidence of stabbing; body found outdoors.	Victim is a prostitute; victim is a street/homeless person.	Quantitative
Chopin et al., 2019 [21]	Relationship offender-victim is stranger; surprise/blitz approach by offender; encounter, crime, and release locations are the same; crime scene deserted; crime took place outdoors or in a parking lot; offender wore gloves, mask, or a condom.	Victim is female; victim is of an ethnic minority; victim is single; victim was jogging or walking at time of offense.	Quantitative
Chiu and Leclerc, 2020 [19]	Offender used minimal force; offender did not use alcohol/drug prior; no vehicle used; no bystanders; crime took place outdoors; one location used; surprise/blitz approach by offender; strategies to prevent recognition; less severe sexual outcomes.	Victim was walking; victim physically resisted.	Quantitative
Chiu and Leclerc, 2021 [20]	Crime took place outdoors; initial contact scene and crime scene are the same; offense ended in escape.	Victim was walking; victim was not incapacitated; victim physically resisted.	Quantitative
Regoezci et al., 2008 [73]	Unknown precrime circumstances; homicide occurred in non-residential indoor, or outdoor setting.	Victim is male; victim is older.	Quantitative

indicated that such personal weapons (i.e., hands and feet), are often characteristic of intimate partner violence [77,79], which is known to have higher clearance rates [43].

With regards to the location of the crime during the crime phase, Chopin et al. [21] discovered that rape cases occurring in a residence are more likely to be solved. Instead, if a rape occurs in a deserted area, outdoors, or in a parking lot, the chances of it being solved decrease. Similar findings have been reported by Regoezci et al. [73], whereby homicides that took place in residences were more likely to be cleared. These findings could be explained by a more significant presence of potential eyewitnesses and CCTV footage within residential areas. Chiu and Leclerc and Chopin et al. discovered that if the entire offense (including contact with the victim) took place in a single location, the offender's chances of going undetected, and therefore the case not being solved, significantly increased [19–21]. With regards to strategies used by offenders to avoid police detection, it was discovered that, while the same number of strategies were employed by offenders for both solved and unsolved cases, cases where offenders used a condom, wore a mask, or gloves, were more likely to remain unsolved [21]. Instead, offenders who threatened the victim or disabled the victim's phone were more likely to be identified and see their cases solved.

In an exploratory study, Brolan et al. [13] examined the locations of contract killings executed by professional hitmen. They gathered articles about 'hits' from global newspapers, analyzed the locations of said hits, and conducted a series of semi-structured interview with an informant; an ex-offender with convictions relating to firearm offenses. They concluded that a specific *modus operandi* (MO; the method used) of a

highly experienced hitman includes a hit taking place at the victim's doorsteps, with only a few bullets fired at close range. If a gun is left at the scene, it will not contain any useful evidence for investigators. When this pattern emerges, it is suggested that, due to the lack of forensic evidence officers will find at the scene, they will need to rely on other efforts, such as monitoring cars and other modes of travel to and from the location of the crime, and national databases [13]. Therefore, a pattern as outlined in this study could be recognized earlier, whereby forensic efforts should be redistributed to more successful avenues to prevent similar contract murder cases from going cold.

Last, with respect to the post-crime phase, cases where semen was left at the crime scene were more likely to be solved [21]. An understandable finding, as it provides officers with a DNA sample of the offender [6]. With regards to the location of the body, it was found that offenders who were in a relationship were more likely to transport the victim's body post-homicide, to ensure that their partners do not suspect their involvement in the crime [7]. Additionally, Chai et al. [17] demonstrated differences between solved and unsolved cases through factors regarding the found body. Factors such as whether the victim's body was concealed, lying faced down, found outdoors, or there was an attempt to destroy evidence, were all associated with the offender being detected rather than the case remaining unsolved. Such findings can inform police investigators to pay attention to the presence (or absence) of these behaviors when assessing a body disposal crime scene.

3.1.2. Victim characteristics

Along with crime characteristics, the articles in this section of the review additionally explored whether victim characteristics were associated with case solvability. Chopin et al. [21] discovered that cases involving female rape victims were less likely to be solved. In contrast to this finding, Regoezci et al. [73] saw that female homicide victims were associated with a faster case clearance. This difference in findings could potentially be ascribed to the different nature of the crimes, one being a sexual crime and one a homicide. Rape cases have notoriously low clearance rates to begin with [68]. One of the challenges to solving rape cases is that they often lack witnesses or physical evidence [82]. Instead, female homicides are more likely to result from intimate partner violence or are committed by a family member, in a residence, leading to a limited number of suspects in an investigation [55,56].

With regards to the age of the victim, cases involving younger victims seemed to be positively related to solvability [21,73]. Instead, cases with older victims were associated with lower solve rates [73]. This difference might be attributed to younger people more likely to be victimized by relatives or people they know, following the pattern of leaving the police with a limited number of suspects [1,73]. Furthermore, Chopin et al. [21] found that within rape crimes with white victims, victims who are in a relationship, and who are physically disabled, have better chances to see their cases solved.

Chai et al. [17] explored whether victim characteristics could predict body disposal patterns. They found that in both solved and unsolved cases, there were two victim characteristics that were significantly related to whether the body was moved: (1) the victim was a prostitute, (2) the victim was a street person or homeless person. However more importantly, they found that the pre-crime phase had the most value for predicting body movement for unsolved cases, and the post-crime phase had the most predictive value in solved cases. This suggests that the victim characteristics, i.e., whether they were a sex worker or homeless, was more likely to lead to body movement patterns congruent with unsolved crimes, and that the offender has likely taken additional steps to remain undetected.

The rational choice perspective present in the offender pre-crime phase to target sex workers, homeless people, and other marginalized groups is not new. According to this perspective, individuals are active and rational decisionmakers, identifying the risks and benefits of committing a crime before deciding to act upon it [23]. Members of marginalized communities, such as female sex workers are particularly

vulnerable, due to the nature of the services they provide and locations they provide them in [76]. Following the rational choice perspective, targeting sex workers, homeless people, and other marginalized groups might pose less risk for the offender to get caught by law enforcement. According to the United Nations Office of Drugs and Crime [84], female sex workers have the highest homicide victimization rates out of all female groups. In fact, female sex workers are 18 times more likely to become a homicide victim compared to women not engaged in sex work [71]. Despite their high risk of victimization, social attitudes and stigmas surrounding sex work create the narrative of sex workers being less than an 'ideal' victim [90,92]. The term 'ideal victim' refers to a victim who is seen as completely blameless for their victimization, outlined by a set of characteristics which includes acting virtuously, being weaker than the offender, and not knowing the offender [22]. When meeting these criteria, this victim will then be granted true victim status and supported with the appropriate resources by law enforcement and the public [11]. While most of society has since evolved from this point of view, some remnants of this belief remain. For example, police and public response towards sex workers reflect their status as a non-ideal victim. Sex workers experience greater victim-blaming when reporting a crime than people not involved in sex work [15,81]. Perhaps more notably, male officers tend to be more lenient towards the offender if their victim is a sex worker [92]. Previous research has also found that sex workers are less likely to be believed when reporting a rape [33], and are thus questioned on their victimhood.

With marginalized groups such as sex workers, but also people with an ethnic minority background or without homes, considered 'lower status' in society and not meeting the criteria of an ideal victim, police decision-makers may allocate more resources towards cases with high-status victims [28,30,80]. This could be due to own biases or pressure from the media and public, where sex workers, homeless people, and others from various marginalized groups receive a lack of attention in the public eye [72]. Inversely, the above findings by Chopin et al. [21] whereby younger victims, white victims, victims who are in a relationship, and who are physically disabled, are more likely to see their cases solved, can cautiously be attributed to the ideal victim narrative as well. Young victims and physically disabled victims are more likely to be seen as weak and virtuous [53]. Additionally, Black individuals are more likely to be attributed offender-status, directly opposed to white victimhood [41,60]. White victims are, for example, considered more newsworthy in traditional media than Black victims in western countries, and is reflective of the institutional racism seen in the media [41, 47].

While cases involving victims from marginalized groups are less likely to be solved or given the attention that similar cases with non-marginalized victims receive, Chopin et al. [21] interestingly had a different finding involving rape victims who were involved in sex work. They found that rape cases involving sex workers were more likely to be solved. This discrepancy can be explained by the outcome of the crimes in the two studies contrasted in this review. Chai et al. [17] examined body disposal patterns, meaning the victims were already deceased. Instead, Chopin et al. [21] studied rape cases, whereby rape victims are alive after the crime occurred, and are able to provide any information they might hold. Additionally, sex workers may be familiar with the offender, as they are often their own clients [4].

The victim's behavior before and during a rape crime seems to be associated with its solvability as well. Results from Chopin et al. [21] indicate that when victims were engaged in domestic activities, sleeping, visiting friends, playing, or sex work at the time of the offense, these cases were more likely to be solved. Cases were more likely to remain unsolved when instead, victims were jogging or walking when the offense occurred. Chiu and Leclerc [20] replicated these findings in the context of sexual offenses. They further found that if the victim physically resisted, the chances of the offender responding by fleeing and/or desisting increased, which in turn was related to the crime remaining unsolved [19,20].

Given the above information, identifying factors relating to 'solvability' can aid police investigators in determining which cases are more likely to be solved and which ones require additional resources. Together, these studies, and the wider literature examining crime and victim characteristics, can be useful as a method to inform investigative decision-making and attempt to uncover new lines of enquiry. Identifying relevant crime characteristics and *modus operandi* can therefore be promising in developing leads in investigations. Additionally, more understanding of the relationship between factors that predict whether a crime is solved can be valuable in directing resources to diminish the chances of a case going cold. The articles discussed identified crime and victim characteristics associated with crimes remaining unsolved, such as the victim walking or jogging at the time of the offense, the offense taking place outdoors, or only one location used for the encounter and the crime. If researchers are able to identify crime characteristics associated with a higher chance of solving a crime, evidence-based guidelines could be developed to meaningfully inform law enforcement officers where to put additional efforts, in turn, lowering the chances of a case going cold in the first place.

3.2. Investigative tools and techniques

Six studies examined 'what works' in already long-term and cold cases. One article within this theme provided a useful exploration of factors which led to successful cold case clearances, and the remaining articles examined the utility of media and expert collaboration in the solving of cold cases. Table 2 summarizes the key features of the studies included within the systematic review categorized as investigation tools and techniques.

3.2.1. Case clearance

A study conducted by Davis et al. [30] investigated cold case solvability using cases from the Washington Metropolitan Police Department (MPD). At the MPD the general homicide review timeline is as follows: 1 day, 15 days, 30 days, and 60 days, at which points there is an emphasis on determining what actions are needed from investigators. In this jurisdiction, cases are considered cold when they have remained unsolved for 36 months. Davis et al. [30] compared cold cases, cleared cases (solved either by arrest or by exceptional means) and unsolved cases. In total they sampled 189 homicides and found that new

Table 2
Summary of key points from articles categorized within investigative tools and techniques.

Reference	Investigation Tool or Technique	Design
Bennett, 2020 [8]	The study examines the use of media in cold case investigation.	Qualitative
Bettels et al., 2022 [10]	The study describes the international collaborative effort between academics and police in cold case work, wherein participants reported significant knowledge exchange and increases in competency.	Qualitative
Byers and DuBois, 2017 [14]	The study investigates successful collaboration between university students from relevant fields and law enforcement, with specific reference to the production of detailed summaries and reports.	Qualitative
Davis et al., 2014 [30]	This study examines factors contributing towards cold case clearance and highlights the need for new leads.	Mixed Methods
Fox et al., 2020 [34]	The study explores the collaboration between academics and law enforcement and highlights how this could help garner unique novel perspectives to aid cold case investigations.	Qualitative
Yaksic, 2020 [91]	The study examines the collaborative effect between investigative journalists and law enforcement agencies and the use of offender profiling to help progress a cold case.	Qualitative

information from existing witnesses or information from new witnesses was the most prevalent reason for case clearance. Additionally, they identified factors from the initial investigation that would improve the solvability of a cold case, for instance, if a prime suspect or a disclosed motivation was present. The odds of case clearance were also affected by the reason by which the cold case was reopened, where it was found that if it was initiated due to family request or routine protocol the odds of clearance were significantly reduced. Davis et al. [30] clearly highlight the importance of finding new, tangible leads or perspectives as being the most prevalent reason for cold case clearance. The following papers provide interesting tools and techniques to discuss alongside these findings.

3.2.2. Media

Bennett [8] used qualitative analysis to identify themes relating to media in cold case investigations. The study reports the results of a seven-month observation period with a two-force collaborative cold-case team in England and was supplemented with interviews with 12 experienced cold-case detectives. In general, participants agreed that media involvement had proven to be useful in obtaining information, especially when paired with memory cues such as strategically employing media on anniversaries of cold cases [8]. Providing media coverage of anniversaries relating to the case demonstrates law enforcement's dedication to solving the case and reminds members of the public that the case remains unsolved [8]. Additionally, media usage can incentivize witnesses who may otherwise be reluctant to disclose information. It may provide a level of anonymity and therefore the confidence necessary to come forward and share potentially important details. In the case of drug or gang related crimes, using media several years later to encourage witnesses can be especially useful, as alliances may have changed since the occurrence of the crime.

However, media usage must be strategic, as negative, or inappropriate portrayals of the crime or victim can at best discourage members of the public with information and at worst hinder investigation efforts. For example, one participant described a media appeal emphasizing victims' drug abuse, which led to members of the public viewing them as a 'glue-sniffer', resulting in a lack of interest and response [8]. Unfortunately, psychological literature has shown time and time again that bias can be a detrimental factor in police investigations, especially cognitive biases within law enforcement. For example, confirmation bias, whereby an officer will search for evidence to support their favored theory [86] or the availability heuristic [42] whereby an officer may use a recent example to inform their decision-making (e.g., they recently arrested a young black male for drug offenses, therefore the next drug offense is likely to be committed by a young black male). Without strategic use of media, it is easy to see how these biases could permeate public dialogue and opinion, to affect not just an investigation but also a trial [70]. With this in mind, another risk is that it can be difficult to control the extent of coverage a case receives. In some cases, a victim's family members have learned about their passing through media coverage of the case, so participants emphasized that a victim's family should be consulted or at least informed before media involvement [8].

Last, media could be an important tool for use of largescale memory retrieval. The wider investigative psychological literature has shown the importance of selective and context-based retrieval [5], i.e., that selective memory retrieval can reactivate the retrieved memory's temporal context during the event, facilitating recall of other items with a similar context. Therefore, strategic use of media could potentially facilitate multiple people's memory retrieval and possible new witnesses for cold cases. It is abundantly clear that used correctly, media can be an incredibly useful tool to promote information elicitation both throughout ongoing cases and in long-term and cold cases. This systematic review also outlined one other clear investigative technique, collaboration with experts in different fields.

3.2.3. Interdisciplinary collaboration

Four papers in this review highlighted the importance of the collaboration between law enforcement and experts in other relevant fields of the criminal justice process [10,14,34,91].

Yaksic [91] introduced the Investigative Journalist/Expert Field Micro Task Force (IJ/EF MTF) model in order to improve evidence-based practice in the offender profiling process in unresolved serial homicides. Offender 'profiling' has been met with resistance over recent years due to its tendency for exaggeration and inconsistent accuracy. However, Yaksic states that this model is not intended to deliver a suspect, but instead to describe the possible offender, and that expectations as to 'who' should be tapered as soon as possible. Similar to Bennett [8], Yaksic recognizes the importance of media in an investigation. They state that joint cooperation with journalists is critical as they provide an invaluable service, broadcasting necessary information to the public in order to garner a response and keep an investigation moving forward. There are three stages to the model: (1) an investigative journalist takes on a particular cold case, interviews relevant parties for information and contacts the Atypical Homicide Research Group (AHRG), (2) the AHRG then reviews and agrees to help, and finally, (3) law enforcement organizations are contacted, and a relationship is built among the two teams. The model was tested in 17 instances, and it was found that profiling alone does not result in the capture of a serial homicide offender but can help to narrow down a suspect pool and that the collaborative efforts between journalists and officers is a positive contributing factor. The model is based on the efforts of investigative journalists to locate and research cases which have the highest likelihood of solvability if reopened, and then to employ a behavioral analyst to assist with research. Therefore, we can see that this model not only helps find new avenues with which to progress a cold case but can help with the limited resources law enforcement organizations themselves experience. Finally, the paper advocates for educating law enforcement officers on what can be gained from collaborating with not just investigative journalists, but also academics which is a key factor in the other three identified papers.

The following three papers have all explored the value of strategic interdisciplinary collaborations between law enforcement investigators and academic partners. For example, Byers and DuBois [14] report the outcome of three projects involving students working on cold case investigations in collaboration with Crime Stoppers and multiple law enforcement agencies. Students were taught the relevant aspects of a cold case investigation, such as the importance of confidentiality, interpreting previous video footage, management of case files, open-source intelligence training (e.g., searching newspaper articles and use of online platforms), etc., after which they were tasked with producing a cold case report. There were multiple obstacles throughout these projects, most notable was how to manage the expectations of both the victims' survivors and the students. Many loved ones of victims experience a negative 'Halo Effect', a cognitive bias whereby in some cases they've felt disheartened at the progress made by law enforcement thus far and therefore have negative expectations of what progress could be made with expert collaboration, even forming the impression their loved one isn't a 'worthy' victim [64,83]. This can increase frustration and reduce cooperation with criminal justice officials, a common issue especially in cold cases. They also had to manage students' own 'unbridled enthusiasm'. Often students thought they would be able to solve the case throughout their 15-week project, in part due to the media effect of major crimes, whereby a crime is solved within 40 min of television. Where this happened, students were reminded that cases were 'cold' because of a reason and that the intention is not to solve, but to assist investigators by amalgamating information and showing commonalities, and searching for new leads. Despite these challenges, it was found that producing detailed cold case reports (1) helped survivors of cold cases by alleviating previous frustrations and showing attention to their case, (2) assisted law enforcement by giving summaries of the cases which officers may not have had the time or resources to complete and

(3) in one case led to the arrest of the responsible individual.

Fox et al. [34] also highlighted the benefits of police collaboration with academic partners in relevant fields; in this instance forensic anthropologists, forensic psychologists, and criminologists. They advocated that by engaging relationships with these experts, it would be possible to use cutting-edge scientific research to inform practice and gain unique perspectives to aid in the development of new leads. Fox et al. [34] report a case study whereby criminology students carefully reviewed all cold case materials in a real-life case and identified what turned out to be a highly significant lead, eventually leading to the addition of new evidence critical to the investigation. Once again, we see the importance of interdisciplinary perspectives on crime, and the gift of additional resources to a struggling area of the public sector.

Most recently, Bettels et al. [10] outlined how the collaboration technique between academics and law enforcement can increase the quality of investigation and competency of those involved. This study focused on international academics and police who participated in the International Cold Case Analysis Project (ICCAP), and their experiences completing the program. The ICCAP was designed with the cooperation of several British, Australian, and German universities and the charity Locate International and has three main objectives: (1) to collect necessary information about the victim, (2) reconstruct the crime, and (3) investigative trace control (evaluate all investigative leads). An additional benefit to this project compared to the previous papers is the international aspect, where it was hoped that individuals from various cultural, institutional, and disciplinary backgrounds would enrich and expand investigative opportunities. ICCAP focused on locating or identifying missing persons and encouraged students to contemplate beyond the boundaries of their own specialism. Participants reported increased competency in their ability to understand case facts and apply their own academic knowledge in the evaluation of existing leads to give a new perspective, thus demonstrating the benefits of academic and police collaboration with the ICCAP.

The advantages to the academic field are evident in all four of these papers, students and experts have gained experience in which to apply their knowledge and gain insight into real-world practice. Additionally, it is suggested that the cold cases analyzed in these publications generated new lines of enquiry from the collaborative efforts between students and investigators. This is in part due to the production of structured summaries and presentations with comprehensive reviews of the victim, pre-crime phase, main-crime phase and post-crime phase, and an evaluation of all leads up until the present. This facilitates further advancement of the case via the highlighting of contradictions, commonalities, and the ability to cross reference [10]. Similarly, a recent literature review sought to identify and synthesize available theories and methods for cold case homicide evaluation and solvability to guide future research [69]. Their review outlines suggestions for cold case investigation that directly support the work of all four of the interdisciplinary papers discussed [10,14,34,91]. It is reported that cold case investigations should be regarded as a team effort involving a mix of investigators, civilians, and forensic specialists. Furthermore, psychological literature has shown that working in multidisciplinary teams, identifying the type of collaboration required and building interpersonal relationships with those teams is important for successful collaboration and outcomes [27].

A final example of multidisciplinary success in cold cases comes from the work of the previously mentioned charity Locate International. It operates in partnership with law enforcement agencies, police forces, universities, and the families of those that have gone missing, and is comprised of expert volunteers from many relevant fields. Their aim is to consider unsolved cases collectively, to better understand how missing persons investigations can be advanced. In recent months this has involved a partnership with psychologists to investigate ways in which to obtain new leads and witnesses by developing information elicitation tools that could be applied in cold case investigations. For example, tools such as The Self-Administered Interview [35], which was originally

designed to obtain statements from cooperative witnesses following a critical incident and is used by police forces throughout the UK, have recently been modified for use in cold case investigations. Moving forward, if multidisciplinary teams of experts can begin to develop evidence-based tools that can be applied for use in cold case investigations, we are much more likely to find new leads, increasing the odds of solvability [30].

3.3. Implications for future research

One of the most important findings of this review is the notable lack of currently available psychological research examining how best to prevent, solve, and inform best practice in cold case investigations. Psychological research has been integral to the development of other areas of evidence-based investigative practice (e.g., cognitive and interpersonal techniques to enhance information elicitation); therefore, it is imperative that more psychological research is conducted with specific reference to long-term and cold cases. For example, we have touched upon how memory retrieval facilitation could be used to help with witness long-term memory retrieval in cold cases, however it may also be useful to look at the field of research within delayed allegation cases. In recent years, we have seen an influx of delayed allegations, especially accusations of sexual assault, which come with distinct challenges, for example, lack of hard evidence and less witness credibility [54]. Similarly, the nature of a cold case means that there was likely a lack of hard evidence at the time of the original investigation and there has not been enough evidence obtained since to reopen the case. Recently developed techniques, such as the 'Timeline Toolkit' [51] have sought to address this very issue by finding new ways to analyze investigative data. Therefore, perhaps comparing methods of evidence re-evaluation within delayed allegation research could be helpful towards improved solvability in cold cases. Furthermore, the issue of witness credibility could be explored both within memory and delayed allegation research. Previous literature has debated how we retrieve memory (e.g., recovered) and its influence on how witnesses are perceived in delayed cases and suggests there is a need to bridge the gap between scientific research and its use in the courtroom [93,94]. There are many avenues of research that could be called upon to test their application in the field of cold case investigation, and it is impossible to predict which will have the most positive outcome. However, what is evidently clear, is that further research is required to understand how to best elicit information gathering, memory retrieval, witness credibility, many other unique challenges that emerge in long-term and cold cases.

Third, as an initial step in understanding the literature, studies in this review were limited to the field of cold case investigation, whereas the wider literature might also be useful to consider. For example, research in memory has highlighted the importance of context retrieval in selective memory retrieval [5] and has suggested promising techniques providing environmental support to improve episodic performance in a criminal justice context, such as, the Self-Administered Interview [35, 46] and the Sketch Reinstatement of Context [29]. It is likely these techniques, and those from other relevant fields can be modified and applied to the field of cold-case investigations.

3.4. Limitations

Conducting a systematic review has enabled us to thoroughly analyze the extant literature on 'what works' in cold case investigations with reference to psychologically informed methods. However, it is important to acknowledge that other relevant articles may have been missed or overlooked because of the variations in terminology and the lack of a clear universal time-point when a case becomes cold. Furthermore, the studies included in this review were all conducted in the United States, the United Kingdom, or Western Europe, and therefore represent western educated, industrialized, rich, and democratic (WEIRD) countries. As such, the findings presented are culturally

specific and further research is necessary in other non-WEIRD countries.

Furthermore, although our search has presented some promising ideas, and has provided a clear structure upon how to interpret and categorize the different methods, tools, and techniques (i.e., into preventative methods which generally center around crime and victim characteristics and investigative tools and techniques which generally focus on the use of media and collaboration between experts), our review was limited by the scarcity of psychological research. With only twelve articles, we have highlighted an evident gap in the literature, showing that this is an area in desperate need of more research and replication. Additionally, most of the articles investigating crime and victim characteristics focused on sexual crimes and homicide, but as previously highlighted in this review, many other crimes can fall under the category of cold cases. Therefore, there is insufficient research to offer conclusive evidence-based recommendations at present.

4. Conclusion

This systematic review, although limited, has highlighted encouraging avenues of research to build upon: (i) preventative methods sourced from crime and victim characteristics [13,17,19–21,73] and, (ii) effective investigative tools and techniques for use in cases already categorized as ‘cold’ [8,10,14,30,34,91]. From the available research on crime and victim characteristics, it appears promising to examine how such case characteristics can help inform new potential leads or predict the likelihood of solving a case. One of the ways the systematic review aimed to inform ‘what works’ in cold case investigations from a psychological perspective, was to gain an understanding on certain characteristics that are associated with solved and unsolved cases, such as location, gender of the victim, and type of weapon used. Research comparing solved and unsolved cases is a sensible place to begin examining the task of case clearance by highlighting the ‘risk’ factors of a case going cold. Such knowledge can in turn inform police decision-making, for instance, by allocating additional resources to the cases with a higher probability of remaining unsolved.

Moreover, while cold case approaches and strategies differ widely, the results of the systematic review also reveal common features which have been found to be effective. Collaborative efforts, such as between academics and police, or between a number of specialists from different domains, including media, have been found to be particularly effective in increasing internal competency through exchange of academic and practical information and experience, and also case clearance [8,10,30,69]. This is a promising model for Cold Case Investigation Units, and one that has already been adopted by Locate International.

Declaration of competing interest

Confirm there are no conflicts of interest.

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