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Original communication

Analysis of the procedures used to evaluate suicide crime scenes in Brazil: A statistical approach to interpret reports

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ABSTRACT

This study uses statistical techniques to evaluate reports on suicide scenes; it utilizes 80 reports from different locations in Brazil, randomly collected from both federal and state jurisdictions. We aimed to assess a heterogeneous group of cases in order to obtain an overall perspective of the problem. We evaluated variables regarding the characteristics of the crime scene, such as the detected traces (blood, instruments and clothes) that were found and we addressed the methodology employed by the experts. A qualitative approach using basic statistics revealed a wide distribution as to how the issue was addressed in the documents. We examined a quantitative approach involving an empirical equation and we used multivariate procedures to validate the quantitative methodology proposed for this empirical equation. The methodology successfully identified the main differences in the information presented in the reports, showing that there is no standardized method of analyzing evidences.

1. Introduction

The initial approach to the crime scene is crucial to case-solving. However, the resources available to each jurisdiction vary.[1] In Brazil, approaches to crime scenes differ even for crimes of the same type. Because desirable uniformity is lacking, a series of questions regarding the procedures for crime-scene analysis and their results may arise. Analysis of material evidence requires greater technical precision to improve the investigative process. Some isolated efforts already exist with respect to creating regulations to standardize the procedures to be adopted at crime scenes.[2] In the USA, for example, the National Institute of justice provides guidelines for crime scene investigation.[3–5]

While homicide consists of killing someone else, suicide is the act of deliberately taking your own life. Many reasons may lead a person to commit suicide, including mental disorders and some physical illnesses.[6] For the USA National Center for Injury Prevention and Control, suicidal self-directed violence is the *"Behavior that is self-directed and deliberately results in injury or the potential for injury to oneself. There is evidence, whether implicit or explicit, of suicidal intent."*[7] Murdering someone and committing suicide are extreme acts of aggression that shock, amaze, and affect society and the closest survivors, as well as the nation's economy. For justice and investigation purposes, establishing the difference between these behaviors is essential to clarify and define the dynamics in a crime scene. International or intercultural comparisons of suicide methods help to gain deeper understanding of the interplay between these two factors, and provide a basis for preventive strategies.[8]

Although the legal and psychological distinctions between homicide and suicide seem to be straightforward, the differential diagnosis of these two forms of violent death is no easy task for the experts during the analysis of a crime scene, especially in cases of suicide simulation. The specialized literature contains reports on cases in which it is difficult to ascertain whether the action is

Abbreviations: RR, Report Relevance; W_v, Variable Weight; F_c, Context Factor; PCA, Principal Component Analysis; KNN, K-th Nearest Neighbor; SIMCA, Soft Independent Modeling of Class Analogies; PLS, Partial Least Squares; LOO, Leave One Out; LNO, Leave N-Out; RMSEV, Root Mean Square Error of Validation; RMSEC, Root Mean Square Error of Calibration.

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homicide, suicide, or accident.[9] Additionally some papers have described suspicious and simulated suicide[10,11]; in very singular situations, homicide simulation can occur.[12]

Despite the complexity of the analysis, experts may reach a satisfactory conclusion about the cause of death if they examine the crime scene thoroughly and identify traces generated during the violent action correctly. The individual analysis of traces and their connection are key to establishing crime dynamics and the criminal's mode of action.

Advances in scientific methodology have influenced the development of expertise in the sense of avoiding biased interpretation. Scientists have improved technical tests which have made forensic investigation more reliable. Scientific methods, specific protocols, statistical tools, and other objective criteria are important in establishing and strengthening forensic work as a science.[13]

When a criminal offense is committed, all the evidence should be assessed jointly. This should be collected and evaluated in order to determine the identity of the criminal.[14] Forensic investigation involves applying a scientific method to crime investigation and provides vital, objective information about the case. Forensic examination consists of the following phases: recognition, identification, comparison, individualization and interpretation of tests.[15]

Recent advances in science and technology have provided forensic scientists with a vast number of methods and techniques. When experts assess the physical evidence, they gather it together and quantify the contribution of a particular suspect in the event. To solve this problem, many experts employ statistical tools in order to interpret the results. Statistical analysis of forensic data has acquired growing importance in courts. Forensic scientists can now evaluate and interpret the evidence that includes elements of uncertainty.[14,16] The literature also reports cases of subjectivity bias is registered on fingerprint and DNA analysis.[17–19]

This study aims to examine expert reports of crime scenes of suicide by using statistical tools to assess the gaps and weaknesses in the procedures described in the reports. Our overall is to gain an idea of the dimension of the problem and offer some positive feedback to official expertise, showing the need to design a standardized procedure for the analysis of crime scenes related to violent deaths in Brazil.

2. Material and methods

Eighty reports of suicide were analyzed after being randomly collected from different jurisdictions and locations. The objective was to evaluate a heterogeneous group of cases to formulate an overview of the analysis.

The first step was to determine the cause of death in each case and then formulate questions about the methodology. There were 19 variables, associated with the questions listed in Table 1. The possible answers were YES, NO or Impossible to Determine (ID), which were attributed values 1, −1 and 0, respectively. A NO answer could account for something that should have existed and constitutes a negative factor for the item. Impossible to Determine, refers to situations when it was not possible to identify any YES or NO answers for the variable, due to lack of information in the report. For example, if the report did not cite clothes, analysis of this variable was impossible. However, this does not mean that experts did not analyze the variable; it only meant that the information did not exist in the report.

From these variables, the overall quality of each report was calculated using the following auxiliary variables:

Report Relevance (RR) determines how representative the report was in terms of the information that it contains; an empirical equation was developed; two parameters were elaborated: Variable Weight and Context Factor.

Table 1
Variables studied in the analysis.

V01	Were injuries characterized in the report?
V02	Did the report contain details about these injuries?
V03	Was the violent act performed by means of an instrument?
V04	Was the instrument collected?
V05	Was the instrument analyzed?
V06	Did the report describe the absence of typical lesions related to fighting or defense?
V07	Were the victim's clothes mentioned?
V08	Were the victim's clothes analyzed?
V09	Was blood at the scene mentioned?
V10	When found, were the bloodstains analyzed?
V11	Was the body position described?
V12	Was the body position related to the dynamics of the facts?
V13	Did the report present a dynamic compatible with the evidence at the crime scene that could rule out homicide (suicide simulation)?
V14	In addition to the tests performed at the scene, were additional laboratory tests conducted?
V15	Did the report discuss the characteristics of the scene?
V16	Is there a classification regarding the characteristics of the crime scene? (*e.g.* reputable or disreputable; mediate, immediate or related etc.)
V17	Was the evidence of violence photographed?
V18	Did the report show a sketch to enable better understanding of the facts?
V19	Did the report use appropriate language (clear, objective, and grammatically correct)?

Variable Weight (*Vw*) is intended to correct distortions regarding the importance of each variable, associated with a numerical value according to the importance of the information, *i.e.*, how significant the specific condition is for the report. The weights were set as 1 when the variable was considered as **relevant**, 2 when it was assigned as **necessary** and 3 when it was considered to be **fundamental**. Table 2 lists explanations of these values in the case of each variable.

Context factor (F_c) is a means of pondering each variable considering the context of the criminal action. It is specific to each report and provides a more sensitive analysis, because the situation can affect the relevance of the variables. For example: the analysis of the instrument was considered to be fundamental, but if the cause of the death was human fall, no further analysis was necessary. In this situation, although the variable is important, its absence is completely acceptable. The same applies if a gun was found to have been used in the crime scene, but the cause of the death was hanging and no bullet wounds are found on the body. In this context, the gun analysis is relevant but not necessarily associated with the case. *Fc* values were 0 for **irrelevant**, which means that the answer does not apply to the studied case; 1 for **relevant**; 2 for **necessary** and 3 when it was considered **fundamental**.

The parameters described above were developed to provide an empirical equation for Report Relevance, given by:

$$RR = \frac{\sum_{i=1}^{n} Wv(i)Fc(i)Vq(i)}{\sum_{i=1}^{n} Wv(i)Fc(i)}, \quad (1)$$

where *Vq* is the variable of the question (sum of answers to the formulated variables). RR ranges from 0 to 1. This equation seeks to provide a quantitative indication of the amount of the information accounted for in each report.

In order to test if *RR* makes sense, it was validated using the following multivariate tools:

a) **Pattern recognition** was used to identify the characteristics of the data set and associate similarities among the data. This was achieved by observing natural clustering (unsupervised