Examining Attributes of Homicides

Toward Quantifying Qualitative Values of Injury Severity

MARK E. SAFARIK
JOHN P. JARVIS
Federal Bureau of Investigation

The empirical value of traditional measures related to homicide, the cause of death, and weapon use are well researched and documented in the literature. This research proposes new scale measures quantifying the degree of injury exhibited in homicide cases that can be used to further examine the dynamics of homicidal behavior. These scales are then tested in an examination of a limited set of data reflecting homicides of elderly women. Normally the purview of trauma studies, where the use of injury scales to assess patient survivability is known, homicidal injury is examined using a similar method as a means for exploring offender and crime scene variables. As proposed here, these injury scales may also prove to be useful in furthering other areas of homicide research.

Keywords: homicide; elderly; quantifying injury severity

Homicide is a widely studied phenomenon using various units of analysis, research designs, statistical approaches, and diverse data sources. From the extant literature on this topic, numerous findings emerge that assist in our statistical understanding of homicidal behavior. In particular, one of the most frequent sources of information on homicides is drawn from the Federal Bureau of Investigation's (FBI's) Uniform Crime Reporting Program, which

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collates and reports Supplementary Homicide Reports (SHRs) from more than 18,000 police agencies annually.

As one of the most widely available sources of data, this information often forms the basis for a great deal of what is known about homicide. For example, the most recent *Crime in the United States* shows that the rate of homicide has declined in recent years to the current rate of 5.6 per 100,000 inhabitants (FBI, 2003). In addition, this publication depicts the demographic composition of homicides in the United States by reporting that homicide victims are predominately male (77%), adult (88%), and where race is reported, evenly divided between victims who were White and non-White. Furthermore, supplemental FBI data show that about 43% of victims had identifiable relationships with their assailants, approximately 28% of murders involved arguments as the predominate circumstance surrounding the offense, and about 64% of these offenses were cleared by law enforcement nationwide in 2002 (FBI, 2003).

Although these statistics are known to homicide researchers and useful in assisting law enforcement, criminal justice professionals, and public policy advocates, it is clear that more research is needed to further an understanding of how these lethal criminal incidents occur and to enhance the likelihood of apprehending the perpetrators of these crimes. One area that may demonstrate promise is further assessment of the injuries that are suffered by these victims. Unfortunately, the data compiled on these criminal incidents are often lacking when it comes to reporting victim injury information. In particular, neither summary data from the FBI *Uniform Crime Report* (*UCR*) nor SHR contains information about the injuries that are suffered by the thousands of homicide victims each year. In fact, very little information about the extent and nature of injuries in homicides is available from any national crime data set.[1]

Perhaps one reason for this omission is the assumption that such information in homicide cases would be of little value because each victim suffered a lethal injury. Such an assumption presumes a constant variable relative to the measurement of injury among homicide victims. Our contention, which has also been recognized in the medical examiner community, is that these injuries are, in fact, variable. Measuring, reporting, and analyzing these data will help further our understanding of how and why

these homicides occur and perhaps assist investigators in not only solving these crimes but also solving them quicker.

To this end, the current research explores the viability and utility of injury measurements in examining the attributes of homicides. In the above section, an overview of some of the scant statistical information on homicidal injuries was discussed. In the next section, the measurement and use of injury scales in other applications are explored. The uses and methods for measuring injury severity in homicides cases are proposed. In the third section, some of the schemes outlined in the previous section are used to propose and generate actual empirical scales for measuring injury severity in homicide cases. Finally, in the last section, data from a recent examination of elderly homicides are used to illustrate the application of these proposed injury measures and provide fodder for speculation relative to the usefulness of injury measures in understanding all types of homicidal behavior.

SCALES AND MEASURES OF INJURY

The qualitative assessment of injury (through description and case studies) is important and often very useful in illustrating the nature of a violent crime and the dynamics of the interaction between the offender and victim. This dynamic is known in the law enforcement community where, anecdotally, the level of injury and the location of those injuries on the body have implied some level of existing relationship (Geberth, 1996; Ressler, Burgess, & Douglas, 1988; Safarik, Jarvis, & Nussbaum, 2000, 2002). This relationship, or lack thereof, has been used by law enforcement to provide investigative direction in many violent crime investigations. However, a thorough examination of the extent of victimization and violence engaged in by the offender, through analysis of the magnitude of injury inflicted on the victim, may also prove useful for quantitatively capturing this distinct component of homicide.

To explore and potentially measure this injury severity variable, one can examine trauma-scoring systems currently used in the international medical community.

The appropriate classification of injuries by type and severity is fundamental to the study of injury etiology. Scales for categor-

izing injuries are grouped into two types: those that assess the physiological status . . . and those that describe the injury in terms of anatomical location, specific lesion, and relative severity. (International Injury Scaling Committee, 1998, p. vii; see also Battistella, Din, & Perez, 1998; Stoner, Barton, Little, & Yates, 1977.) The effects of injury may be defined in terms of input—an anatomical component and related physiological response—and output—mortality. Because these trauma-scoring systems assess living patients, mortality is the outcome that has garnered the most interest.

A number of methods for determining the injury severity of trauma patients have been developed during the years. These methods, based on the type and anatomical distribution of injuries, have been generally classified in two ways. Some evaluations use anatomical scores such as the Abbreviated Injury Scale (AIS; Committee on Medical Aspects of Automotive Safety, 1971) and the Injury Severity Score (ISS; Baker, O'Neill, Haddon, & Long, 1974), whereas others use physiological scores, which measure the physiological responses to injury, such as the Glasgow Coma Scale (GCS; Teasdale & Jennett, 1974).[2] What is clear from these measurement instruments is that in the field of medical trauma, many injury metrics are used, and constant revisions are under way to provide for more situation-specific schemes. As a consequence, the medical community has a long history of using injury metrics to improve our ability to evaluate and to respond to trauma and injury.

The current research, taking a lead from the medical community, examines homicide injury severity and attempts to illustrate how such measurements may enhance our understanding of homicidal behavior. In doing so, the consideration of homicidal injuries, by their very nature, eliminates from consideration scoring schemes utilizing physiological scores of living victims and, instead, focuses attention on the anatomical scoring of injuries observed among homicide victims. Reflecting this scoring scheme, and using previous injury scoring schemes as a foundation, Baker and colleagues (Baker et al., 1974) designed the ISS, a system that was capable of expressing the cumulative effect of injury to several known body regions.[3]

In computing the ISS, each injury is assigned a score from 1 (*minor*) to 6 (*not survivable*) and allocated to one of six body

regions: head and neck (injuries to the skull, brain, or cervical spine); face (injuries involving the mouth, ears, nose, eyes, and facial bones); chest (injuries to internal organs, diaphragm, rib cage, and thoracic spine); abdomen or pelvic contents (internal organs and lumbar spine); extremities (sprains, fractures, broken bones, dislocations, and amputations); and external areas (lacerations, contusions, abrasions, and burns independent of their location on the body).

The ISS is defined as the sum of the squares of the single highest score in each of the three most severely injured body regions. This standard has been found to correlate better with mortality than other scoring systems (such as the AIS) and has been generally accepted as the benchmark summary measure of anatomic injury (Semmlow & Cone, 1976). The ISS provides a reliable, easily coded, and accurate instrument by which the severity of injuries can be assessed. Furthermore, for more than 25 years, the ISS has proven to be an empirically robust injury measurement tool and successfully used worldwide (Osler, Baker, & Long, 1997). This measure provides the ability to evaluate the nature and severity of injuries seen in homicides and, more important, those injuries related to the cause of death.

A word about cause of death may be useful in the current research. Most homicide studies attribute weapon use to cause of death as indicative of the homicidal injury. This weapon use is commonly addressed in most national studies including the FBI's *UCR* data (FBI, 2003), SHR, and the National Incident-Based Reporting System (NIBRS).[4] For all homicides and the majority of other autopsies performed each day throughout the United States, the medical examiner identifies and describes qualitatively and quantitatively the minutia of each injury, its severity, and relationship to the cause of death. Therefore, cause of death is the "disease, *injury* [emphasis added], or abnormality that alone or in combination is responsible for initiating the sequence of functional disturbances, whether brief or prolonged, that eventually ends in death" (Froede, 1990, p. 9). This is somewhat different from the mechanism of death, which is the process that causes one or more vital organs or organ systems to fail when a fatal disease, injury, abnormality, or chemical insult occurs. It is the functional or structural changes that make independent life no longer possible after a lethal event has occurred (Froede, 1990). Because of the

complexity and lack of specificity associated with the mechanism of death, medical examiners usually focus on identifying the cause(s) of death. Analyzing the details of the medical examiners' report generally provides the information necessary to differentiate between postmortem and ante mortem injuries, assess the severity of an injury along a continuum from superficial to fatal, and determine the presence or absence of a nexus between a particular injury and a cause of death. These details range from an anatomical examination of the body and organ systems at the macro level to a histological review of tissue samples.

PROPOSED SCHEMES FOR MEASURING INJURIES IN HOMICIDES

As noted from the outset, crime data officially reported to the police are of limited utility when examining homicides relative to cause of death. Although weapon use is available in these data, there is no clear indication how these weapons were used, how many injuries were inflicted, or the severity, location, type, and nature of the injuries sustained by the victim. The NIBRS shows some promise for attending to this lack of injury data. However, injury data in NIBRS are not reported for homicides. As previously discussed, because the victim's injuries resulted in death, the severity of those injuries is regarded as irrelevant.

Even if the injury data in NIBRS were available for homicides, the reporting categories captured in the current design of NIBRS provide a limited delineation of victim injuries. The NIBRS response categories record only whether the victim suffered a major, minor, or no injury in crimes against persons.[5] As has been noted and is the major contribution of the current research, the nature and extent of injuries are very valuable to investigators, prosecutors, jurors, and judges in their assessment of an offender's behavior. Such information may then be used to interpret additional crime scene attributes not only in homicides but also other kinds of violent crime.

To this end, unlike the previously discussed trauma scoring systems where the outcome—mortality—is a dichotomous variable (i.e., lethal vs. nonlethal), the outcome in homicide cases is always a constant—lethal. In consideration of the importance of

injuries in homicides, it is hypothesized that injury severity patterns and their measurement are important for understanding the dynamics of the behavior that occurred in these events; that is, there is a discernable difference in offender behavior between one who kills the victim with little or no external or excessive injury and another who spends considerable time and effort inflicting excessive injury involving multiple causes of death. Furthermore, quantitative measurement of injury nature and severity could add to a greater understanding of the variation and dynamics within homicide and provide the basis for discriminating between different forms of homicide. Examples of these forms include infanticide, eldercide, sexual homicide, and impulsive or ritualistic homicide (Hazelwood & Warren, 2000).

Other than the obvious observation that all homicide victims die as the result of their injuries, no other nexus between various causes of death are commonly identified. There is no dispute that the cause of death is an important variable and certainly necessary, from a statistical perspective, in evaluating an important component of homicide. However, it is clear that the diverse means by which death is inflicted precludes the ability to develop a useful measurement of injury based solely on cause of death. Substantive data on the cause of death does not provide sufficient information about other related aspects that are likely important. Specifically, the number, severity, location, and nature of the injuries and their relationship to cause of death need to be evaluated. Comparing homicides with similar causes of death is also problematic, in terms of the level of violence displayed and the varying degree of injury severity.

Injury Severity Score (ISS)

As a result of the current line of inquiry, the quantification of homicidal injury is proposed in this article as follows. The ISS, as discussed earlier, is well known and has been used extensively for trauma research (Baker et al., 1974). Modification of the ISS scoring scheme to a measure of injury severity that codes all injuries sustained by victims would be useful toward the ends sought here—the quantification of homicidal injury. Modification of the ISS is necessary because it requires all victims in homicides to sustain injuries that were not survivable (score = 6). A score of 6 in

any body region receives the maximum ISS score of 75. Because all victims in the current study have at least one body region with a score of 6, use of that constant value (not survivable) without modification would have made it impossible to code meaningful injury scores because all victims would have received a score of 75. As a result, a score of 6 is recoded into a 5 to denote a body region that sustained a fatal injury. This modification still allows for a maximum score of 75 as is used in the ISS.

Homicide Injury Score (HIS)

Before providing an example of this scoring scheme to illustrate the logic and dynamics of the measurement, a second alternative measure may also be appropriate to explore; that is, coding specifically only those injuries directly related to the victim's cause(s) of death. Instead of coding for all of the victim's injuries, as the modified ISS does, further delineating the nature of the injuries may prove more useful in differentiating offender variables. The need for differentiation and, therefore, more specificity and accuracy in victim injury analysis lead to the development of a second scheme for measuring homicidal injuries—termed here the HIS. This alternative measure is proffered for the purpose of providing a quantitative standard measure of the degree of injury. This measure can be used to compare injuries across a large sample of cases for which different and multiple causes of death and attendant levels of injury exist. The HIS attempts to further capture the qualitative element of a victim's fatal injuries (within the context of homicide) in a quantitative manner. This is accomplished by quantifying the severity of only those injuries that are directly related to the cause(s) of death through a detailed review of the medical examiner's autopsy report and related protocols.

Following this scheme, the HIS was formulated to capture the number of causes of death and related injury severity as identified by a medical examiner. The proposed values and attendant interpretations for the HIS are shown in Table 1.

As described in Table 1, the HIS and modified ISS are similar in construct but capture different homicide attributes relative to injury severity. This can be seen more clearly by comparing the ISS and HIS scoring schemes proposed in the current research. Using the ISS, scores of 25 to 49 represent a single body region

TABLE 1
The Homicide Injury Scale (HIS)

1	Single cause of death only: internal injuries only with no visible related external injuries (e.g., smothering, strangulation, ruptured organs resulting from blunt force trauma)
2	Single cause of death only: internal injuries only with minor related external injuries (e.g., smothered with related abrasions and/or contusions of mouth and face, strangled with related abrasions or ligature marks)
3	Single cause of death only: related external moderate to serious injuries not identified as either excessive or overkill[a]
4	Two or more causes of death: related internal and/or external injuries not identified as either excessive or overkill[a]
5	Single cause of death only: related external injuries identified as either excessive or overkill
6	Two or more causes of death: related internal and/or external injuries in at least one of the causes of death identified as either excessive or overkill

a. An in-depth discussion of the term *overkill* is beyond the scope of this article. It is a term that has been described in practice as ante or perimortem injury in excess of that that is necessary to cause death (Douglas, Burgess, Burgess, & Ressler, 1992).

with a fatal injury. Similarly, HIS scores from 1 to 3 denote a single cause of death without excessive injury. ISS scores of 50 to 75 correspond to at least two separate body regions sustaining fatal injuries similar to HIS scores of 4 to 6 that denote excessive injury or overkill and/or multiple causes of death. Examples of this logic and application of these scoring schemes will better illustrate the dynamics of these injury measures. Consider the following case examples drawn from this research that are illustrative of the homicidal injury scoring schemes of the ISS and HIS.

Case One

An 87-year-old female was found dead, stripped nude on the bed in her apartment located in a high-rise apartment complex. The offender crushed her skull using a clock from the nightstand, strangled her with his hands causing severe neck trauma, and used a knife from the kitchen to stab her repeatedly in the chest and vaginal area.

Scoring of the injury scales would adhere to the following scheme: Because the victim suffered at least two causes of death (actually three) and there were excessive injuries in at least one of those causes, the maximum HIS score is a 6, as illustrated in Table 1. Following the ISS scheme, because the victim sustained

TABLE 2
Injury Severity Scoring Procedure: Case Example 1

Body Region	*Raw Score*	*Subtotal Score (Raw Score Squared)*
Head and neck: crushed skull and manual strangulation (fatal)	5	25
Face: multiple lacerations (severe)	4	16
Chest: multiple fatal stab wounds (fatal)	5	25
Abdomen: multiple stab wounds to vaginal area (fatal)	5	25
Extremities: multiple contusions (moderate)	2	4
External: (serious)	3	9
Total injury severity score (sum of three highest scored body regions)		75

fatal injuries to three separate body regions, each of these injuries would be scored a 5 and totaled as illustrated in Table 2.

Case Two

A U.S. postal employee checking the welfare of a 92-year-old female found her deceased in the bedroom of her single-family home. He had not seen the victim for several days, and her mail remained untouched in her mailbox. She was wearing a nightgown that had been pushed up above her waist exposing her genital area. Her cause of death was determined to be strangulation.

The scoring scheme for this case would be dictated by the following facts: The victim died of strangulation (single cause of death only) with minor related external injuries. Table 1 dictates that an HIS score of 2 is the appropriate result. Similarly, the ISS scoring would be dictated by the fatal injury that was suffered in one body region (head and/or neck) along with other minor injuries. The ISS scoring for this case follows the procedures outlined in Table 3.

Analytical Uses of the Proposed Injury Scales: Application to Homicide Studies

The scoring schemes outlined above are hypothesized to be of use in showing variation in homicide cases and should be useful for determining the dynamics of the interaction that took place

TABLE 3
Injury Severity Scoring Procedure: Case Example 2

Body Region	*Raw Score*	*Subtotal Score (Raw Score Squared)*
Head and neck: manual strangulation (fatal)	5	25
Face: contusions (minor)	1	1
Chest: no injuries	0	0
Abdomen: no injuries	0	0
Extremities: contusions (minor)	1	1
External: (minor)	1	1
Total injury severity score (sum of three highest scored body regions)		27

between offender and victim in these crimes. This idea emerged from previous research devoted to classifying cases by cause of death and by efforts to examine qualitative data that seem to indicate varying levels of violence and injury to homicide victims. However, unlike the scoring and assessment systems used to assess traumatic injury in living patients, no viable mechanism existed to quantitatively evaluate those differences for victims of homicide. This problem highlighted the need to quantify the extent of injury associated with each cause of death, as it would enable homicide researchers to compare and contrast injury in a condensed, useful way without solely relying on qualitative, subjective descriptions. Furthermore, by applying such measures as an explanatory variable to a broad sample of homicide cases, one could evaluate how injury may or may not relate to different aspects of offender violence or aggression (as captured in overt offender behavior variables). This measure may also prove useful in differentiating between cases of different types.

DATA AND METHOD

To test the viability of these injury scoring procedures, data on a variety of homicide cases with detailed information on not only injuries sustained but also complete information on a variety of case details were preferable. Unfortunately, as noted previously, data of this nature are not widely available. As such, the data that are examined in the current research reflect a set of 128 elderly

homicide cases that were collected by the FBI's National Center for the Analysis of Violent Crime (NCAVC) through various sources.[6] Cases were identified through the FBI's Violent Criminal Apprehension Program (VICAP), brought forward by law enforcement through their participation in the FBI's National Academy Training Program and through the operational activities of the FBI's NCAVC. The cases represent regional variation with cases from more than 30 states. These cases involved a female, age 60 years old, who was determined to be a victim of a homicide.

Following Burgess, Hartman, Ressler, Douglas, and McCormack (1986), this data collection involved a comprehensive review of the behavioral and psychological details of the homicides through analysis of the offender's physical, sexual, and when known, verbal behavior with the victim (see also O'Toole, 1999). This also includes a complete study of the victim, a thorough evaluation of the crime scene, and an in-depth investigation of the nature and scope of the interactions between the victim and the offender. These records were very comprehensive and usually contained investigative, autopsy, forensic and evidence analysis reports, crime scene and autopsy photographs, diagrams, sketches and maps, victimology information, offender background, and any confessions or admissions by the offender. Psychological evaluations of the offender were provided in a number of the cases. In addition, investigators who worked on these cases were contacted to clarify or provide supplemental information not identified in the police reports.

Clearly, for statistical and methodological reasons, it would be impossible to fully examine every aspect of these incidents with the relatively small number of cases available. Nonetheless, examination of these data was conducted in two stages. First, the descriptive information available from these incidents was examined in an effort to fully depict the circumstances of these cases (see Table 4). Second, for the purposes of the current research, we narrowed our focus to four dependent variables: race of offender, age of offender, relationship of victim to offender, and distance of offender's residence (in blocks) from that of the victim. These dependent variables were selected for analysis because these attributes are most likely to assist law enforcement investigators confronted with solving such cases (Safarik et al., 2000, 2002).

TABLE 4
Descriptive Statistics: Analysis of Elderly Homicide Cases (*N* = 128)

Variable	M	SD
Offender race	.41	.49
Took items	.72	.45
Neighborhood composition	.58	.50
Offender age	1.60	.50
Victims' state of dress	3.09	7.91
Injury severity score	47.40	16.93
Offender distance	.42	.50
Homicide injury scale	4.58	7.87
Offender known to victim	.55	.50
Victim's body left	1.02	5.78
Method of entry	.41	.49
Time of day	.20	.13
Cause of death	2.51	1.02

NOTE: Scaling for the above variables was computed as follows: Offender race: 0 = Black, 1 = White and Offender age: 1 = between age 15 and 24 years, 2 = older than age 25 years; Offender distance (from victim's residence): 0 = 6 blocks or less, 1 = more than 6 blocks; Offender knew victim: 0 = victim unknown to offender, 1 = victim known to offender; Victim's state of dress (when found at crime scene): 1 = fully dressed, 2 = partially dressed, 3 = nude; Method of entry: 0 = no force, 1 = forcible entry; Time of day: 0 = 10:01 pm to 8:00 a.m., 1 = 8:01 a.m. to 10:00 p.m.; Cause of death (by weapon and/or method of kill: 5 = gunshot, 4 = stab and/or cut, 3 = blunt force trauma, 2 = strangulation (manual or ligature), 1 = smothering, airway occlusion, torso compression, etc.; Neighborhood composition (neighborhood 80% or greater White): 0 = 79% or less White, 1 = 80% or more White; Injury Severity Score (ranges from 25 to 75, see text) and Homicide Injury Score (ranges from 1 to 6, also see text); Victim's body left (at crime scene): 0 = uncovered, 1 = covered, 2 = displayed; Took items (from crime scene): 0 = none taken, 1 = items taken.

Each dependent variable was then examined separately using logistic regression models. Particular attention was given to the degree of probability to which each independent variable could contribute to the explanation of variance in the dependent variable. The set of independent variables represents crime scene variables, victim characteristics, and specific offender behavior.

Examination of the available 128 cases of elderly homicides revealed aggregate descriptive statistics, as shown in Table 4. Specifically, these homicides were committed primarily by Black offenders older than age 25 years, living within 6 blocks of their victim. In addition, the victims knew the offenders prior to the attack, little or no force was involved in entering the victim's residence, and intentional excessive injury was seen in nearly one half (48%) of the cases. Finally, other attributes of these cases indicate a likelihood that items were taken from the crime scene, that these incidents occurred in racially homogeneous neighbor-

hoods, and that the weapon used to kill these victims was most often a personal weapon (hands, fist, or feet). Although these attributes may be somewhat consistent with expectations in cases of this nature, the variation in injuries that resulted from these confrontations are not immediately obvious nor are they adequately measured by utilizing just cause of death.

Using the scoring schemes proposed in the current research, the ISS and HIS scales were calculated for each case. The aggregate descriptive statistics for these measures are also reported in Table 4. The mean ISS of 47.4 and HIS of 4.58 suggest higher levels of injury resulting from these homicides. The mean ISS alone suggests, on average, that although one injury resulted in death, other body regions also sustained serious to severe injuries; that is, the mean indicates one or more of the nonfatal injuries could be characterized not only as severe but also as potentially excessive.

Correspondingly, the HIS represents a similar characterization of injury in these cases. The mean values reflect at least one injury that caused death, alongside other severe or excessive injuries that most likely would have led to death. The slight variation between the ISS and the HIS is because of the fact that the ISS captures all injuries, regardless of their relationship to the cause of death. The HIS, on the other hand, captures only those injuries related to the cause of death. This specificity afforded by the HIS not only captures injury severity related to cause of death but may also prove especially useful to law enforcement investigations of homicide.

Multivariate Analysis

Although these descriptive measures are useful in examining homicidal victim injury, the question still remains: How or in what way do these measures relate to the other incident attributes of homicides? Therefore, a multivariate analysis was utilized to attempt to shed light on these relationships. Logistic regressions were calculated to examine whether the offender attributes of race, age, relationship to victim, and distance the offender lived from the victim were related to the degree of injury suffered by the victims of elderly homicides. As is shown in Table 5, the injury scales were not helpful in predicting offender race or the offender-victim relationship.[7] However, when examining offender age

TABLE 5
Logistic Regression Results:
Analysis of Homicide Characteristics in Elderly Homicides

Variable	b	*Odds Ratio*	χ^2	*Percentage Corrected*
Offender race				
Took items*	–.97	.38		
Neighborhood composition*	1.70	5.51	21.63**	69.40
Offender age				
Victim's state of dress**	–1.90	.15		
Injury Severity Score*	–.02	.98	20.18**	65.60
Offender distance				
Homicide Injury Scale*	–.30	.74		
Neighborhood composition**	1.23	3.40	13.25**	72.30
Offender knew victim				
Victim body left*	–.51	.60	5.06**	61.00

NOTE: Variable details listed in Table 1.
*$p < .05$. **$p < .01$.

and analyzing the distance from victim residence to that of the offender, the injury measures are shown to be of significance in correctly classifying these cases.

Furthermore, in similar analyses, these injury scales performed similarly whether conceived as the HIS or the ISS measures. This is not surprising as these measures are highly correlated ($r = .77$). Finally, the odds ratios suggest that greater injury severity measures indicate an increased likelihood of a younger offender (younger than age 25) and increased odds of the offender living in close proximity to the victim (less than 6 blocks).

This analysis demonstrates that these measures of injury severity suggest an inverse relationship between offender age and offender proximity to the crime scene; however, no statistical relationship relative to offender race or relationship variables. From an investigation standpoint, these findings suggest that extreme injury may be indicative of a more youthful offender who is local to the crime scene. Determining whether these relationships would persist in other types of homicides requires further study and analysis. Furthermore, although race and relationship variables appear to have little correlation with composite injury severity measures in this analysis, it is possible that such characteristics may emerge as important in further examinations of general homicide cases. Such cases exhibit a wider range of variance in

incident attributes than the elderly homicide cases examined in the current research. For example, some believe that injuries to the face are indicative of a relatively intimate relationship between offender and victim (Douglas et al., 1992; Le, Dierks, Ueeck, Homer, & Potter, 2001). The current analysis did not find such a relationship. This is likely because of the composite nature of the injury measures (including severity, location, and lethality), which could obscure a more singular relationship between location of injury and relationship between offender and victim.

DISCUSSION AND CONCLUSIONS

Most homicide studies examine weapon use, or more broadly cause of death, as attributes of homicidal injury. These attributes are commonly addressed in most national studies including the FBI's *UCR* data (FBI, 2003), SHR, and NIBRS (FBI, 2000). Other large studies such as the Chicago Homicide Data Set capture similar basic injury data. Despite these extensive data collections, little if any homicide research has examined the severity of injury as an independent variable to predict offender attributes. Most studies consider only the cause of death, which assumes no variation in injury because every victim suffered a lethal injury.

Characterization of injury severity has been shown to be critical to the scientific study of trauma. Extensive research has been conducted to assess trauma and injury severity in patients for a variety of reasons (Oreskovich, Howard, Copass, & Carrico, 1984; Stoner et al., 1977). One of the most important roles for injury severity scoring is in trauma care research, where the scientific study of the epidemiology of trauma and the resulting outcomes would not be possible (Battistella et al., 1998). The current research applies similar methods to the study of injury severity in homicide cases. Because outcome (death) is a constant value in all cases, it clearly carries no value in this assessment. Instead, injury severity is used to predict different dependent variables, in this case offender attributes. However, this approach was challenged by the lack of any established empirically valid scales for quantifying injury severity in homicide victims. Hence, proposed methods for constructing such scales are inspired by existing trauma scoring systems and tested in the current research using data

selected from homicides of elderly women. This group seemed particularly appropriate because their advanced age and related inability to effectively defend themselves generally ensured that the severity of their injuries was not likely to be related to the offender's inability to gain or maintain control of these victims.[8] As a result, it was likely that any severe injury would be related to the offender's intent to inflict such injuries. The level of injury exhibited in a number of the cases in the current study was found to be excessive and is an attribute believed to be distinct from other violent crimes. It is interesting to note, Groth (1978) and Pollock (1988) found similar results in earlier studies of elderly sexual assault and homicide. Qualitative analyses of these cases further suggest that variation in the degree of injury suffered may be a useful measure to analyze offender behavior. To identify a way these cases could be compared using the severity of the victim's injuries, two scales were created to quantify the severity of those injuries.

The first, the HIS, draws on available medical examiner data ranking injury severity from 1 to 6. Not relying solely on this convention, a second measure, the ISS (currently used by the Centers for Disease Control and Prevention) is utilized by adapting an injury scale developed by Baker et al. (1974).[9] The HIS and the ISS proved straightforward to use and appropriate for quantifying the qualitative components of homicide injury severity. Although the HIS and ISS metrics are slightly different, these measures provide quantitative evidence supporting the differentiation of levels of homicidal injury as an attribute of these cases.

These scales also revealed that many victims suffered multiple, severe, and excessive injuries. The mean for both injury metrics approximated the range of the scale synonymous with excessive injury. Finally, the HIS and ISS were then used in subsequent analyses to further the examination of offender characteristics. They were shown to be useful in providing statistically significant offender variable information within a limited data set reflecting homicides of elderly women. As such, an accurate method for quantitatively measuring injury severity has many potential applications.

Although other aspects not addressed by the current research could also be considered (i.e., the level of familiarity, the degree of psychosis, etc.), the focus of this article has been directed toward

formulating injury severity scoring techniques and analyzing the degree to which victim injury scales may be associated with offender attributes in homicides. To this end, the injury scales proposed and utilized in the current research were found to be useful. However, it should be cautioned that these measures represent a beginning rather than an end to metrics for analyzing injury severity in criminal behavior. Nonetheless, the findings discovered in the cases examined in the current research suggest that excessive homicidal injuries were indicative of an offender who is younger and local to the crime scene. Extension of the methods and procedures to other types of homicide may find different results. In the meantime, this analysis clearly suggests that quantifying injury severity in homicides produces statistically viable metrics that may provide investigative direction and assist the police in identifying potential homicide suspects. This approach also suggests directions for future homicide research. Consider, for example, forensic or police field studies applying scoring schemes along the lines suggested by the current research to examine a wider variety of homicides. Still other areas that might be explored include examining the utility of injury-scoring schemes in lethal and nonlethal (typically aggravated assault) cases, and examination of injury scales as a solvability factor for law enforcement to utilize in efforts to increase clearance rates. In any event, the procedures suggested in the current research for quantifying qualitative values of injury severity in homicide cases show promise for exciting avenues of future research.

NOTES

1. The National Center for Health Statistics, a component of the Centers for Disease Control and Prevention, does collate injury information with some detail along the lines discussed in the current research. However, these data reflect ambulatory care visits to hospital emergency departments rather than those relating to intentional criminal injury in homicide cases (see, e.g., McCaig & Nghi, 2002). Moreover, the necessary detail of severity and character of these injuries are not reported in the current data.

2. Additional injury measures are also in use that include, but are not limited to, the Acute Physiology and Chronic Health Evaluation (APACHE; Knaus, Zimmerman, Wagner, Draper, & Lawrence, 1981), the Revised Trauma Score (RTS; Champion, 1989), New Injury Severity Score (NISS; Osler, Baker, & Long, 1997), and the International Classification of Disease, Ninth Edition (ICD-9) Injury Severity Score (ICISS; Osler, Rutledge, Deis, & Bendrick, 1996). In addition, there are combination system scores such as A

Severity Characterization of Trauma (ASCOT; Champion et al., 1990) and the Trauma Score–Injury Severity Score (TRISS; Boyd, Tolson, & Copes, 1987).

3. The first useful anatomical scoring system was created under sponsorship of the American Medical Association (Committee on Medical Aspects of Automotive Safety, 1971). This resulted in the development of an Abbreviated Injury Scale (AIS) and incorporated the pioneering injury scaling work of De Haven (1952) at Cornell University. The AIS and the scales derived from it are anatomical scales that score the injuries themselves and not the consequences of the injuries. The AIS is a consensus-derived anatomically based system that classifies individual injury severity on a 6-point ordinal scale ranging from 1 (*minor injury*) to 6 (*lethal injury*) using nine body regions at more than 1,300 individual anatomical sites. More details on coding anatomical injury using the AIS are discussed elsewhere (International Injury Scaling Committee, 1998).

4. The NIBRS Program is a redesign of the traditional FBI Uniform Crime Reports (*UCR*) data collection.

5. The exact reporting categories for injury in NIBRS include the following categories: none, apparent broken bones, possible internal injury, apparent minor injury, other major injury, loss of teeth, and unconsciousness (FBI, 2000).

6. Preference would have been to examine a wider range of homicidal victimizations. As such the data analyzed in the current research serve as only an initial test of the viability of these scales. Future analyses of data collected in a more prospective, rather than retrospective, fashion and representing a wider variety of homicidal behavior would contribute significantly toward the development of injury-scaling techniques and their role in understanding homicides.

7. A similar analysis as presented in the current research focusing on broader dimensions than the utility of injury measures in homicides can be found in two earlier studies (Safarik, Jarvis, & Nussbaum, 2000, 2002).

8. Forensic evidence in the cases examined suggests that most victims were readily subdued either because of a blitz attack, ineffectual resistance, or simply they did not resist their attacker. Oreskovich, Howard, Copass, & Carrico (1984) also suggested that the elderly population may be more susceptible to injury because of aging effects.

9. Original scoring is based on location and severity of the injury on the body with scores ranging from 1 being *minor* to 6 being *unsurvivable*. Modifications to this scoring scheme were required when coding cause of death injuries in homicides with resulting minimum values of 25 (a single-body region sustaining a fatal injury) and a maximum of 75 (three body regions receiving fatal injuries). A full discussion of the original scoring scheme can be found by referencing Baker, O'Neill, Haddon, & Long (1974) and Yates (1990).

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Mark E. Safarik *is a supervisory special agent in the Federal Bureau of Investigation's Behavioral Analysis Unit at the FBI Academy. He specializes in the behavioral analysis of violent crime with an emphasis on sexual assault and sexual homicide. In addition to case work internationally and within the United States, he has conducted extensive research on sexual assault and homicide of elder women. He holds a B.S. in physiology from the University of California, Davis and is completing his M.S. from Boston University. He has authored works that include publications appearing in* Homicide Studies, Journal of Interpersonal Violence, Juvenile Sexual Homicide, *and* Offender Profiling. *He has been an FBI agent more than 21 years. Prior to joining the FBI, he was a California police detective. His law enforcement career spans 29 years.*

John P. Jarvis *is a senior scientist-criminologist in the Behavioral Science Unit at the FBI Academy. His work focuses on crime analysis, crime trend research, and the initiation and support of various research efforts by local, state, and federal law enforcement. His recent criminological work involves examining validity and reliability of national crime statistics, analyses of serial crimes, and measuring and exploring the behavior of computer criminals. He holds a Ph.D. in sociology from the University of Virginia and has authored and coauthored numerous works that include recent publications appearing in* Journal of Contemporary Criminal Justice, Journal of Interpersonal Violence, *and the* Journal of Trauma, Violence, & Abuse. *He also has served as an adjunct professor in social sciences at several universities.*