

WORKPLACE HOMICIDE IN NORTH CAROLINA, 1994 – 2003:  
A CASE SERIES AND AN EXAMINATION OF RECOMMENDED  
PREVENTION STRATEGIES

Kelly Kathleen Gurka

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Approved by:

Stephen W. Marshall

Carri Casteel

Dana P. Loomis

Sandra L. Martin

David B. Richardson

Carol W. Runyan

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## ABSTRACT

KELLY K. GURKA: Workplace Homicide in North Carolina, 1994 – 2003: A case series and an examination of recommended prevention strategies  
(Under the direction of Stephen W. Marshall)

Although intentional violence is an important cause of occupational fatality, limited research has been conducted examining the epidemiology of workplace homicide. Most of that research has focused on robbery-related violence. Although recommendations for preventing workplace violence exist and many are widely implemented, no studies have systematically assessed whether these strategies reduce the risk of homicide when the perpetrator had a prior relationship with either the workplace or at least one of its employees (prior-relationship homicides). Two studies to address this topic were undertaken.

In the first study, a case series of occupational homicides in North Carolina occurring from 1994 through 2003 was assembled. Robbery-related and non-robbery-related events were contrasted and classified using a previously published occupational violence typology. Most North Carolina occupational homicides occurred during robbery of the workplace (63%), and strangers perpetrated over two-thirds (73%) of the robbery-related killings. However, a sizable fraction (37%) of occupational homicides during the study period were not robbery-related. Perpetrators with a prior relationship with the workplace or an employee committed 89% of non-robbery-related homicides. Homicides not related to robbery occurred in a range of industrial sectors (retail: 28%, service: 26%,

and manufacturing: 22%), whereas robbery-related homicides occurred overwhelmingly in the retail sector (67%).

In the second study, a case-control study examined whether recommended environmental attributes and administrative policies, thought to be protective of robbery-related violence, reduce the odds of prior-relationship homicide. The case-control study suggested that workplaces located in an industrial park, employing minorities, reporting a history of violence, open any night hours, or open 24 hours any day were more likely to experience prior-relationship homicide. Keeping entrances to the workplace locked when employees were present (OR = 0.36, 95% CI: 0.13, 0.99) and having at least one security device (OR = 0.28, 95% CI: 0.10, 0.74) appeared to protect against prior-relationship homicide.

In summary, non-robbery-related homicides were shown to constitute a meaningful proportion of occupational homicides, and the characteristics of these cases differ significantly from those that are robbery related. Some strategies typically recommended to prevent robberies and subsequent violence may also be effective at preventing prior-relationship homicides.

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## ABBREVIATIONS

ABL	<i>American Business Lists</i>
BLS	Bureau of Labor Statistics
CFOI	Census of fatal occupational injuries
CI	Confidence interval
CPTED	Control and prevention through environmental design
IRB	Institutional review board
ME	Medical examiner
MER	Report of Investigation by Medical Examiner
N	Number
NACS	National Association of Convenience Stores
NC	North Carolina
NC OCME	North Carolina Office of the Chief Medical Examiner
NIOSH	The National Institute of Occupational Safety and Health
OR	Odds ratio
PPE	Personal protective equipment
Q	Question
RQ	Research question
SIC	<i>Standard Industrial Classification</i>
US	United States of America
YPLL	Years of potential life lost

## CHAPTER 1

### BACKGROUND AND SIGNIFICANCE

#### **1.1. Introduction**

Violence has garnered increasing attention as a public health issue in recent decades. The World Health Organization recognizes the dramatic increase in intentional injuries throughout the world and has distinguished violence as a leading international public health problem (3). Americans are not immune to this crisis. Indeed, the United States leads the developed world in firearm violence (4), and homicide is a leading cause of death for Americans less than 45 years old (5). Unfortunately, the workplace has shown to be an important venue in which these crimes occur (6).

American employees annually spend, on average, about 20% of their time working (7). With one fifth of each year spent at the workplace, any significant risk in the workplace to an employee's health is of critical importance.

#### **1.2. Fatal Occupational Injury**

Data from fatal events in the workplace are systematically collected and compiled by the United States Department of Labor in its Census of Fatal Occupational Injuries (CFOI) (6). Data generated and verified by both State and Federal sources are used to create a count of fatal work injuries as well as profile fatal occupational injury events. In

2005, a total of 5734 injuries causing death to workers in the United States were recorded (8). These injuries accounted for 4.0 deaths per 100,000 workers during the year (8, 9).

The fatal occupational injury rate declined through the last two decades of the last century (10-12). Unintentional injuries, which accounted for about 85% of fatal occupational injuries steadily declined at about 3% annually, as did the all-cause mortality rate, whereas the mortality rate due to homicide experienced a much smaller reduction with less than a 1% annual average decline (12). It is not clear whether these trends are reflective of intentional improvements to safety or a change in the composition of dangerous jobs in the employment pool. However, they suggest that fatal occupational injury is likely preventable through occupational health and safety intervention.

The magnitude of the problem, however, continues to be noteworthy with 16 workers dying in the United States on a daily basis from occupational injuries, suggesting a heavy burden to the worker, his or her industry, and society as a whole (13). However, the incidence of fatal occupational injuries alone demonstrates only a portion of this burden. When viewed from the perspective of years of potential life lost (YPLL), the societal burden is even more striking due to loss of future productivity and contributions to the American economy. On average, nearly 36 years of potential life are lost when a worker falls victim to a fatal occupational injury (14). Such a loss is profound for not only the worker and his or her employer but also society as a whole.

These losses have an economic cost associated with them as well; however, quantifying these costs has been problematic (15). Both direct and indirect costs need to be considered. Despite these challenges, at least one method measuring the economic burden of fatal occupational injuries has been developed (13). According to these

estimates, the yearly lifetime cost to society for these premature deaths ranges from just over \$4 billion to nearly \$6 billion, in 1999 dollars. It is worth noting that the method developed to estimate these costs is conservative, and therefore likely underestimates the true cost to society. Furthermore, these estimates do not include intangible losses such as emotional damage incurred by the decedent's family. Although perhaps immeasurable, these losses are also of great import when considering the impact of work fatalities.

Homicide, the second leading cause of fatal occupational injury among women and the fourth leading cause of such deaths among men, accounts for a sizable fraction of the fatal occupational injuries sustained by Americans each year.

### **1.3. Occupational Homicide**

In recent decades, occupational homicide has received increasing attention as an occupational safety and health problem. Violence is no longer viewed as a problem strictly under the purview of the law enforcement community (16). Rather, the impact of violence has become a focus for occupational health researchers, and justifiably so, for intentional injuries have or will affect nearly all workplaces (16, 17). In 2006, workplace violence accounted for more than 400 of the fatal occupational injuries among men and nearly 27 % of all occupational injury deaths (n = 428) among women in the U.S. (8).

Occupational homicides declined both in number and rate between 1993 and 2002, significantly more than the diminution in the general US homicide rate (18). However, the reduction in the number of homicides has slowed over the last five years (8). The lower rates of homicide are driven primarily by a reduction in the rate of robbery-related homicides (82% of all workplace homicides over the decade) in the workplace, which

mirrors the decline in robbery-related homicides in the US population over the same time period (18). The decline is hypothesized to be due in large part to economic prosperity in the United States during this time period and may reflect cyclic trends in crime rates in general (18). Despite similar reductions in intimate partner homicide in the US, workplace homicides resulting from intimate partners have experienced a significantly slower reduction when compared to the other types of workplace homicide. US workers remain at risk of homicide in the workplace, perhaps especially among victims of intimate partner violence.

Victims of occupational homicide tend to be young. For victims of occupational homicide, the average number of years of potential life lost (YPLL = 37.1) is greater than that for all causes combined (YPLL = 35.9) indicating homicide victims are younger on average (14).

In addition, homicide has shown to be the second most costly cause of fatal occupational injury behind motor vehicle incidents with a total cost of about \$11.5 billion dollars (1999 dollars) from 1980 to 1997 (13). A more recent estimate puts the mean annual cost at \$800,000, and these estimates do not attempt to quantify losses such as emotional distress and loss of productivity of those associated with the decedent (19). Given its incidence, the young age of its victims, and the economic costs associated with it, homicide as an external cause for fatal occupational injury is an important source of occupational mortality.



#### **1.4. Classification of Occupational Violence**

Research examining workplace homicide has been conducted across many disciplines including public health, criminology, business, and the social sciences. In examining workplace violence, occupational safety and health researchers often utilize a typology for classifying violent events based on both the perpetrator's motive to commit the violence and relationship with the workplace and its employees. First described by the Consultation Division in the California Department of Industrial Relations' Division of Occupational Safety and Health, and later published by Howard, workplace violent events were initially divided into three different categories (1, 20). Those violent events, in which the perpetrator, having no legitimate relationship with the business, entered the workplace intending to commit a criminal act such as robbery, were classified as Type I. To receive a classification of Type II, the violent event had to be perpetrated by a legitimate recipient of services or goods from the workplace. Examples of Type II events include those in which a patient assaults a healthcare provider, a prison inmate attacks correctional personnel, or a student guns down an educator.

When the classification system was first developed, Type III was comprised of crimes for which the perpetrator was associated with the workplace through employment or with an employee of the workplace through personal relationship (2). When the workplace violence typology was subsequently expanded, Type III events were defined by employee on employee violence (2). Perpetrators of Type III violence were either a current or former employee of the workplace (2). Type III events, highlighted by copious media coverage, are erroneously thought by the general public to define workplace violence (1). In truth, these events (often referred to as "going postal") are far less

common than the occurrence of Type I events (which comprise 37 – 82% of workplace homicides depending on population under study) (18, 21).

The final category to which these violent events can be assigned is Type IV. During Type IV events, the perpetrator is related personally to an employee of the workplace. (2). These relationships include intimate partners, family members, and friends. Intimate partner violence entering the workplace is a common circumstance during which Type IV events occur.

In addition to identifying recognized risk factors present in the workplace, these types of workplace violence, included in the *Injury and Illness Prevention Model Program for Workplace Security*, were described to assist California workplaces assess their risk of violence and whether a comprehensive program aimed at preventing such violence from occurring is indicated (20). Recognizing that the circumstances in which workplace violence occurs vary broadly by type, prevention efforts can be tailored to each workplace based on their risk of experiencing each type of violence (1).

This classification system was first described and used by the California Department of Industrial Relations (1). Investigators in California began to not only utilize the typology in their research but also expanded it to four categories (2, 20). This classification system is now utilized to focus etiologic research as well as assist in the development of prevention activities and has experienced use by occupational safety and health researchers as well as regulatory agencies (2, 18, 20, 22-24).

## 1.5. Workplace Violence Prevention Strategies

Occupational health and safety researchers have characterized the incidence, identified risk factors, and proposed strategies to reduce the risk of workplace violence (21). Based on these findings and in response to the growing problem of workplace homicide, the National Institute for Occupational Safety and Health (NIOSH) published an ALERT in September 1993 for workplaces requesting assistance in preventing homicide in the workplace (25). The ALERT described some of the known characteristics of workplace homicide, identified high-risk industries, and chronicled potential risk factors and preventive measures. NIOSH followed with the release of a *Current Intelligence Bulletin* in 1996, which more thoroughly covered the topic of workplace violence (26).

The bulletin reviews the risk factors for workplace violence recognized at the time of the publication and includes a series of recommendations for the prevention of such violence. The recommendations are divided into three main categories by type of intervention: environmental attributes of the workplace, administrative policies implemented by the employer, and behavioral strategies aimed at the employees in the workplace.

The bulletin suggests physically separating employees from customers, clients, and the general public (26). This separation can be achieved through a number of measures, including counters and bullet-resistant enclosures. It is plausible that these types of barriers may be effective at deterring or mitigating potential violence perpetrated by former employees, clients, and acquaintances of employees.

Another recommendation made by NIOSH regarding the physical environment of the work site involves visibility and lighting (26). Ensuring visibility of high-risk areas of a business from outside, and adding bright exterior lighting, may act as deterrents against prior-relationship homicide. Good visibility and exterior lighting may deter potential perpetrators exterior to the premises, including current or former employees, customers, and acquaintances of employees.

NIOSH also recommends controlling access to, and egress from, work areas (26). Whether the work site is easily accessible to non-employees and former employees, and how quickly a potential perpetrator can exit the premises, may have an effect on the likelihood of violence in a particular workplace. However, this particular design feature may be less likely to have an effect on violence perpetrated by current workers during their regular shifts because they inherently have access to the workplace.

Security devices such as cameras, alarms, and two-way mirrors are another environmental attribute suggested by NIOSH (26). These devices may prevent or minimize the severity of assaults against workers related to disputes. They might have the potential to dissuade violence committed by a perpetrator with a prior relationship to the workplace, regardless of whether they are routinely at the workplace, because these devices may assist in the apprehension of offenders. If system, however, is faulty, current and former employees may be aware of this, rendering the device useless.

In addition to recommendations about the environmental attributes of the workplace, NIOSH suggests several administrative policies that employers can adopt to lower the risk of workplace violence (26). The first of these controls involves staffing plans and work practices. NIOSH suggests increasing the number of staff for the retail

and service industries. Furthermore, the use of security guards and receptionists to screen people seeking access and to control entry of such persons into work areas is suggested. Both of these administrative policies are likely to have less effect on disputes among current employees, but they may provide protection against perpetrators that are customers, former employees, or acquaintances of employees.

The final prevention recommendation made in the bulletin explored in this dissertation involves behavioral strategies, i.e. training employees to handle violent situations (26). Training to handle all types of workplace violence may reduce the risk of such violence escalating to homicide.

## **1.6. Workplace Homicide Research**

Although a number of studies have examined the characteristics of workplace homicides, few have described the circumstances of these events in detail (21, 27-30). The majority of studies have been limited by data available only from death certificates or from reporting mechanisms from which the surveillance data came. No studies have systematically examined prior-relationship homicides. In addition, there is a wide-spread perception among researchers that the workplace violence typology simply corresponds to whether the homicide involved a robbery or not.

Only two studies have examined the effectiveness of strategies to prevent workplace homicide, and they did not systematically examine prior-relationship homicides (31-33). What intervention research does exist has focused largely on robbery deterrence, particularly in industry-specific settings (34-41).

As discussed above, environmental attributes of the workplace include physical barriers separating employees from the public, visibility of the employees from the exterior of the workplace, bright exterior lighting, and the use of security devices. Loomis, et al. found physical barriers between employees and the public to be protective against workplace homicide; however, this finding was not true of the dispute-related (defined as the non-robbery-related events) homicides in particular (32). Hendricks, et al found that bullet-resistant shielding, in particular, was protective against convenience store robbery (36). In light of these findings, it is plausible that physical barriers may only be effective at preventing robbery-related homicides. In prior-relationship homicides, the perpetrator inherently has access to the area behind the barrier, or can easily gain access to this area as a result of the prior relationship, so the barrier may be ineffective at preventing this type of homicide.

Results from studies regarding the visibility of the interior of the workplace from the exterior have been mixed. A review of the convenience store literature found that both visibility and lighting appear to reduce both robberies and homicides (42). Clearing obstructions from store windows has been suggested to convenience stores to reduce the risk of robbery, although Schaffer, et al. saw no effect on the odds of workplace violent injury, and Loomis, et al. found no effect on the odds of homicide during a robbery. However, a reduction in the odds of homicide was observed for dispute-related homicides (32, 33, 42-44). Potentially, visibility into the workplace deters would-be perpetrators from assaulting employees, or exterior visibility somehow allows the mediation of an assault thereby lessening the severity, or workplaces where the interior is visible from the outside generally have a lower risk of prior-relationship homicide. Loomis, et al. also

saw a reduction in the odds of occupational homicide associated with bright exterior lighting for both robbery-related and dispute-related homicides, as did Schaffer, et al. on the odds of workplace violent injury (32, 33). Bright exterior lighting may function in a manner similar to external visibility in preventing or mediating prior-relationship homicides.

Using security devices in the workplace for crime deterrence has also received mixed reviews. Roesch and Winterdyk found security devices reduce the risk of robbery, but Erickson and Crow found security devices to have no effect on the risk of robbery (42, 43, 45). For workplace violence, mirrors and alarms may afford protection, but research thus far does not suggest that security cameras alone have a protective effect (32, 33). Perhaps these security devices work to deter homicides from occurring, or they may function by alerting someone else to an assault that can then be mediated before it proceeds to a fatality. Conversely, use of security cameras may be a consequence of the crime rate in the area surrounding the workplace, possibly explaining some findings that suggest that cameras are a risk factor for violence.

As discussed above, the administrative policies and procedures include limiting access to the workplace, training employees with regard to workplace violence prevention, and staffing procedures including stationing a security guard or receptionist at the workplace entrance and never allowing employees to work alone. Little research has been conducted to examine the effect of limiting access to the workplace. Loomis, et al. report non-significant decreases in the odds of workplace homicide for keeping entrances closed or locked at various times (32). Although these strategies may be effective for certain types of prior-relationship homicide such as intimate partner violence, current

employees and customers typically require access to the workplace, thus circumventing this prevention strategy.

A number of studies suggest that employee training is protective against robbery, robbery-related non-fatal injury, and robbery-related homicides (36, 38, 42). In addition, a Crime Prevention Through Environmental Design (CPTED) intervention incorporating a training component used in California liquor stores was shown to be effective at reducing both robbery and injury (37). However, employee training was not shown to be effective at protecting against either workplace homicide or nonfatal workplace injuries (32, 33). Because training programs can be so disparate and the quality of training can vary, it is difficult to interpret these findings. Training, given an effective program, may well have a protective effect against prior-relationship homicide by teaching employees how to de-escalate workplace violence once it ensues.

The literature on the suggested staffing practices is mixed. Having more than one employee present at night, for instance, and stationing guards in the workplace have been shown to decrease robberies. However, when a robbery does occur, the extra employees present may increase homicides because of the additional potential victims and, in the case of guards, increased levels of violence (42). Some studies have shown that having only one employee on duty, however, increases the risk of both robbery and homicide, and protecting the workplace with a security guard may protect against robbery-related homicides (32, 46). Another study showed no effect of having one versus more than one employee on duty during a robbery event with regard to risk of injury (35). When looking at only the dispute-related homicides, Loomis, et al. found an increased odds of homicide with both protection by security guards and more than one employee usually



working (32). However, inferences from these estimates are limited by their imprecision. Although working alone may be protective against employee-on-employee violence between current employees, having multiple employees present may protect against customer and intimate partner violence. However, it may also increase the likelihood that an employee involved in a violent relationship is present and susceptible to violence at any given time.

In addition to the interventions discussed above, a number of risk factors for workplace homicide have been identified in previous studies. Workplaces experiencing a homicide are more likely to have night hours of operation (32, 33). Operating twenty-four hours a day also appears to increase the risk of homicide (32, 33). Studies have also suggested that small businesses are at increased risk of robbery and related violence (47). Loomis, et al. found that being in the current location for a short period of time was associated with increased risk of homicide (31). Two studies have also suggested that the physical location of the workplace may affect risk of homicide, and physical location has also been shown to be associated with robbery risk as well as severity of robbery (32, 33, 48-50). Employee race has been shown to be associated with workplace homicide (25, 32, 51-53). The NIOSH recommendations list contact with the public as a risk factor for workplace violence as well (25, 26). Finally, previous studies have shown that a history of violence in a workplace is strongly associated with subsequent violence occurring in that workplace (33, 54).

## **1.7. Study Rationale**

### *1.7.1. Occupational homicide case series*

Research on workplace homicides has largely focused on robbery-related violence (18, 34-40). Less is known about non-robbery-related workplace homicide. Thus, I describe epidemiologically occupational homicides in North Carolina in the years 1994 - 2003, comparing robbery- and non-robbery-related incidents. In order to achieve this goal, I applied an expanded typology of workplace violence, which includes robbery as a motive. I examine how well categories of the workplace violence typology correlate with robbery motive and discuss, based on the findings, implications for intervention development and adoption by employers.

### *1.7.2. Examination of workplace violence prevention strategies*

Much of the research examining workplace violence prevention strategies has occurred within the context of robbery-related violence, and recommendations set forth by the National Institute for Occupational Safety and Health are heavily influenced by findings from robbery prevention research (26, 34-40, 48). No studies have been undertaken to systematically assess whether the recommended workplace violence prevention strategies are effective in preventing prior-relationship homicide (32, 33). Because no study had examined prevention strategies in the context of prior-relationship homicide, I examined whether recommended environmental designs and administrative policies, thought to be protective of robbery-related violence, also reduce the odds of prior-relationship homicide in the workplace.

## CHAPTER 2

### STATEMENT OF SPECIFIC AIMS AND RESEARCH QUESTIONS

#### 2.1. Specific Aims

Although prior studies have explored robbery-related workplace homicides, those workplace homicides that are unrelated to robbery have gone largely unexamined in epidemiologic research. Hence, the first study aim was **to provide a description of workplace homicides occurring in North Carolina by detailing the specific circumstances surrounding fatal workplace violence in North Carolina**. Homicides related to robbery were contrasted to homicides unrelated to robbery. The relationship of the perpetrator to the business and its employees was explored.

The National Institute for Occupational Safety and Health (NIOSH) has issued a list of prevention strategies to guide workplaces on measures for preventing workplace violence (26). However, these measures are largely unevaluated. Although these strategies have been recommended for the prevention of all workplace violence, their effectiveness for preventing violence that is both perpetrated by known assailants and unrelated to robbery events is largely unknown. Thus, the second study aim was **to examine whether recommendations made for the prevention of workplace violence are associated with a reduction in the odds of occupational homicide in North Carolina workplaces not related to robbery that were committed**

**by perpetrators with a prior relationship to either the workplace or at least one of its employees (prior-relationship homicide).**

## **2.2. Research Questions (RQ)**

**RQ1: What are the specific circumstances surrounding fatal workplace violence in North Carolina?** To address this question, I assembled a comprehensive case series of all occupational homicides occurring in North Carolina workplaces, 1994 – 2003, and classified the case series by the precipitating motive for the fatal event (robbery or non-robbery), and the perpetrator’s relationship to the workplace and its workers (Types I through IV, per Peek-Asa, et al (2)). Differences between robbery and non-robbery events were assessed. The data are presented, stratified by motive (robbery or non-robbery) and the relationship of the perpetrator to the business and its employees (Type I to IV, per of Peek-Asa, et al (2)).

**RQ2: Are recommendations for preventing workplace violence associated with a reduction in the odds of workplace homicide unrelated to robbery and committed by a perpetrator with a prior relationship with the workplace or its employees?** To address this question, I conducted a case-control study in which cases were workplaces that experienced a prior-relationship homicide from 1994 to 2003 and controls were a sample of North Carolina workplaces. The specific recommendations evaluated were:

- a. Physical separation of employees from customers, clients, and the general public,
- b. External visibility of employees,
- c. External lighting,

- d. Restricting access to the work area,
- e. Use of security devices,
- f. Staffing plans, and
- g. Employee training for handling violent situations (26).

Other recommendations made by NIOSH excluded from this evaluation were the implementation of cash-handling procedures, the utilization of personal protective equipment, and the adoption of policies and procedures for assessing and reporting threats. Cash handling procedures were excluded due to the lack of plausibility of an effect on events unrelated to robbery, and data were unavailable for the other recommendations.

## CHAPTER 3

### METHODS

#### **3.1 Overview**

Records from the Office of the Chief Medical Examiner (NC OCME) for all homicides occurring in NC from 1994 through 2003 were reviewed, and all cases of occupational homicide were ascertained. I classified each incident by motive (robbery or non-robbery) and type (I through IV) (1, 2, 20). Quantitative data as well as qualitative information were collected and organized. I computed descriptive statistics for these data. Chi-square tests were performed to test for differences between robbery- and non-robbery-related events, and I report exact p-values when expected cell counts were less than five.

For those cases occurring in the workplace identified as non-robbery and Types II through IV, a questionnaire addressing various aspects of the physical environment and the administrative policies of the workplace was administered to the workplace manager or, if the workplace manager was unavailable (47% of cases), the investigating law enforcement officer (hereafter referred to as proxy informants). To examine recommended workplace violence prevention strategies, I compared these cases to a group of control workplaces. After conducting this univariate analysis, I fit logistic regression models controlling for potential confounders using exact methods.

## 3.2. Data Collection

Data collection occurred in three stages: during the conduct of *A North Carolina Study of Workplace Homicide*, during the conduct of *Homicide During Robbery: A Case-Control Study*, and during the primary data collection phase of this dissertation (31, 32).

### 3.2.1. Phases of data collection

Much of the data utilized for this dissertation research was originally collected as part of *A North Carolina Study of Workplace Homicide* (31, 32). The homicide review and ascertainment of cases of occupational homicide (including cases with both robbery and non-robbery motives) was conducted for homicides occurring from 1994 through the first quarter of 1998 as part of this original study, as were the questionnaire data obtained from workplace managers and proxy informants. Finally, I utilized the control group of workplaces from this original study for the case-control study that examined the recommended prevention strategies.

The second phase of the homicide review and case ascertainment occurred during the subsequent study, *Homicide During Robbery: A Case-Control Study*. For the robbery study, researchers extended the homicide review through the end of 2000. Although only homicides occurring as a result of the commission of a robbery were included as cases in this subsequent study, researchers enumerated all of the cases of occupational homicide regardless of motive. For the dissertation research, I then administered telephone questionnaires to managers of those workplaces.

The final phase of the homicide review and case ascertainment occurred as part of this dissertation research and was continued for homicides occurring through the end of

2003. In addition, I administered the questionnaire to workplace managers or proxy informants for those additional events qualifying for inclusion in the examination of currently recommended workplace violence prevention strategies.

The different phases of the homicide review, case ascertainment, and questionnaire administration are shown in Table 3.1.

### *3.2.2. Occupational Homicide Case Series*

To address aim one, I assembled a case series of workplaces experiencing an occupational homicide in the state of North Carolina, 1994 – 2003. I then classified each case by both motive and the perpetrator’s relationship to the workplace or its employees.

#### *3.2.2.1. Homicide Review, Case Ascertainment, and Data Collection*

A review of homicides was conducted in the Office of the Chief Medical Examiner of North Carolina (NC OCME) for the purpose of ascertaining cases of workplace homicide. North Carolina law requires that all deaths resulting from injury be investigated by a medical examiner (ME). In addition, the Report of Investigation by Medical Examiner (MER) must be filed in the NC OCME. Thus, all deaths due to injury, including those caused by violence, have an MER in the NC OCME along with a copy of the official death certificate. Based on this system, it is possible to create a list of all homicides occurring on the job in the state. The North Carolina ME system is well established: quality control measures are in place, and it has been used extensively for studies of occupational fatalities (30, 31, 52, 55-60).



To construct the case series of these occupational homicides, I requested a list of all North Carolina deaths with the manner of death classified as homicide for victims at least 10 years of age for the years 2000 through 2003 from the NC OCME. Each case was then individually reviewed in either the Chapel Hill or Charlotte offices of the NC OCME. Research Associates in the Department of Epidemiology performed the homicide review for 1994 through 2000 (methods detailed elsewhere) (31). For the dissertation research, the homicide review was performed for 2001 through 2003.

For each case, the OCME file contains the MER and the death certificate for the victim. Each record may contain additional information such as newspaper clippings, police reports, and toxicology results. Both the MER and the death certificate contain data fields indicating whether or not the decedent was on-the-job at the time of death; however, the data recorded in these fields is open to interpretation (56). Thus, we conducted a more thorough review utilizing additional information in the record rather than relying solely on these fields, so that we could be certain we were accurately identifying cases of workplace homicide.

For the period 2000-2003, for deaths clearly occurring at work and those in which the event precipitating death potentially occurred at work based on the information present in the MER or death certificate, an entry was made in a case log. The records were then abstracted. I applied the *Operational Guidelines For Determination of Injury at Work* developed and disseminated by the Association for Vital Records and Health Statistics (now the National Association for Public Health Statistics and Information Systems), the National Institute for Occupational Safety and Health (NIOSH), the National Center for Health Statistics, and the National Center for Environmental Health

for assessing whether each homicide occurred at work (61). When the information present in the record was insufficient to determine whether a case occurred on-the-job, I contacted law enforcement agents and consulted newspaper articles to obtain additional details on the circumstances of the event. Based on additional information provided by these sources, I classified questionable homicides by on-the-job status. Cases, the workplaces in which the event precipitating an employee homicide occurred, qualified for inclusion when the fatal injury occurred in North Carolina, the violent injury occurred at work, death resulted within 365 days of injury, and the precipitating event did not involve illegal transactions, e.g. prostitution or illicit drug dealing. In addition, I excluded workplaces classified as police protection or national security because violence experienced in these industries is distinct from that of other industries and their workplace settings are not conducive to evaluating environmental features like those in other industries (62).

The methods used to ascertain cases of occupational homicide were consistent across all three phases of data collection with one exception. In the first two phases, all homicides occurring at migrant labor camps were considered to be on-the-job, whereas in the third phase, only homicides for which the victim was likely engaged in work activities at the time of the fatal event were considered workplace homicides. In order to ensure consistency, I reexamined all homicides occurring at migrant labor camps for the first two phases, 1994 through 2000, to determine whether the victim was likely engaged in work activities at the time of the homicide rather than off-duty activities in the living quarters of the camp. Only those events for which the victim was on-the-job at the time of the fatal injury were included in the case series reported here.

The employer location for eligible events was then identified from the MER or by contacting the law enforcement agency investigating the homicide. The workplace was the unit of analysis rather than the individual, as a single event resulting in more than one homicide was included in the case series only once. However, two separate homicide events at the same workplace occurring at different times were counted as separate, independent events. As mentioned above, workplaces in the law enforcement and military industries were excluded because both violence experienced in these industries and the workplace setting is distinct from that of other industries.

From the MER, I also abstracted the exact date and time of the onset of injury, the weapon used to perpetrate the assault, and the circumstances of each event leading to the on-the-job death. The latter were abstracted from the narrative summary of circumstances surrounding the death portion of the MER, but when this summary was limited, I consulted law enforcement agents familiar with the homicide as well as newspaper accounts.

#### 3.2.2.2. Classification of Occupational Homicides by Motive

After the occupational homicide case series was assembled, each case was first classified by whether the motivation for the crime was robbery or non-robbery. The circumstances of each event were reviewed; additional information was sought as necessary from law enforcement agents. To be classified as having a robbery motive, there had to be evidence or suspicion by law enforcement agents that was strongly supportive of a robbery motive. Otherwise, the event received a motive classification of non-robbery.

### 3.2.2.3. Classification of Occupational Homicides by Type

In addition to motive, cases were classified by the relationship of the perpetrator to the workplace and/or its employees as described in Section 1.4 (1, 2, 20). If no relationship between the perpetrator and the workplace or its employees existed and the perpetrator was only at the workplace for the purpose of participating in criminal activity, I classified the event as Type I. This category included mostly robberies, but also included other crimes, such as drive-by shootings.

For a case to be classified as a Type II, the perpetrator of the crime had to be a customer legitimately interacting with the workplace at the time violence ensued. An offender who posed as a customer in a convenience store to reduce suspicion who then proceeded to rob the establishment was classified as a Type I. If, however, the offender was conducting a legitimate transaction prior to the subsequent robbery, the event received a classification of Type II.

For a Type III classification, the perpetrator had to be a current or former employee of the workplace. When the perpetrator had a known personal relationship such as familial relation or friendship with any employee of the workplace at the time of the crime, I assigned the event to Type IV. All personal relationships, including both intimates and non-intimates, were included in this category.

For eleven cases, more than one type could be assigned to the event based on multiple relationships between the perpetrator and the workplace or its employees. For two of the events, the perpetrator was both a legitimate customer at the time of the onset of violence as well as related in some way to an employee of the workplace. I classified

these two cases as Type II events because the perpetrator's relationship as a customer of the workplace led to the perpetration of the crime in that workplace at that time.

Similarly, nine events could be classified as both Types III and IV because the perpetrator was a current employee of the workplace as well as known personally to the victim. For these nine events, I classified the case Type III. Because this crime occurred at work, the co-worker relationship was deemed to play a larger role in committing the crime at that place and time; it was the co-worker status of the perpetrator and victim that led to the occurrence of that crime in the workplace at that time. However, these cases may differ from other Type III crimes because the personal relationship likely played a role in the motivation for the violence.

### *3.2.3. Examination of Workplace Violence Prevention Strategies*

To address aim two, I conducted an examination of the current recommendations made by the National Institute for Occupational Safety and Health (NIOSH) for preventing workplace violence by comparing case workplaces, those having experienced a qualifying homicide, to a group of control workplaces, a sample of North Carolina workplaces, with regard to these prevention strategies.

#### *3.2.3.1. Identification of Case Group*

For this comparison, the study included cases of non-robbery-related workplace homicide classified as Type II, Type III, or Type IV. Exclusion criteria are further described in Section 5.3. A manager from each of these workplaces was invited to complete a questionnaire, including questions regarding the use of the recommendations

undergoing examination. When workplace managers were either unwilling or unable to participate, law enforcement officers familiar with the homicide were invited to participate as proxy informants. These data collection efforts are described more fully in Section 3.2.3.3.

### 3.2.3.2. Control Selection

The control workplaces identified and interviewed during *A North Carolina Study of Workplace Homicide* were utilized as the comparison group for this evaluation (31, 32). Due to limited resources, I was not able to extend the control group to the end of the study period, December 31, 2003. Control workplaces were originally sampled from all North Carolina workplaces found on the *American Business Lists* (ABL) (63).

The risk set for each identified case included those workplaces listed on the ABL that were in operation during the month of the case event, that did not have a homicide during that month, and were assigned to the same one-digit *Standard Industrial Classification* (SIC) category (B – mining, C – construction, D – manufacturing, E – transportation and utilities, F – wholesale, G – retail, H – real estate, insurance, and finance, I – services, and J – public administration) as the index case workplace (62). Agricultural workplaces were excluded because no comprehensive sampling frame for farms existed.

Ten potential controls were selected from each risk set; the first two of the ten control workplaces agreeing to participate were interviewed. Because incidence density sampling was used, controls were selected with replacement, and cases could be selected

as controls. In practice, however, no individual workplace was selected twice or included in both the case and control groups.

#### 3.2.3.3. Questionnaire Administration

The primary source of data for the examination of prevention strategies was a telephone questionnaire administered to workplace managers or proxy informants, as indicated. Loomis, et al. developed the survey instrument for the original study, *A North Carolina Study of Workplace Homicide*, and this instrument was administered to both cases and controls (31). I used these data for this study and adapted the questionnaire for use during the additional case interviews. The content of the questionnaire in terms of the instrument elements was unchanged from the original version; I made only cosmetic changes such as the instrument title (see Appendix A).

Once additional cases were identified during the review of homicides in the NC OCME and classified by motive and type, I contacted each workplace manager via telephone. The purpose of the initial contact was to establish the identity of the workplace manager (see Appendix B). Once the mailing address was verified and the manager's name was determined, I mailed an introductory letter (Appendix C) to each potential respondent.

A week was allowed to pass before the investigator again contacted the workplace by telephone. I used the second contact script (Appendix D) to determine whether the manager receiving the letter was employed at the time of the qualifying event and to gauge interest in completing the survey instrument. When the manager had not been employed at the time of the homicide, an alternate with knowledge of the workplace at

that time was sought. If the manager was willing to respond to the questionnaire but could not do so at the time of the contact, I established a later date and time at which the manager was willing to participate. If, however, the workplace manager was both willing and able to participate in the interview at the time of the second contact, informed consent was obtained by assent to participate, and I administered the instrument.

For workplaces no longer in existence or for which the manager refused to participate, the investigating officer assigned to the homicide case was contacted. When both willing and able, this law enforcement officer completed the questionnaire as a proxy informant. When the investigating officer was unavailable, another law enforcement agent familiar with the case was sought to complete the instrument. Researchers from *A North Carolina Study of Workplace Homicide* and I completed telephone questionnaires for fifty-five (80%) of the sixty-nine eligible workplaces. Of the fifty-five completed questionnaires, workplace managers or a suitable substitute participated in twenty-nine (53%).

### **3.3. Analysis**

To address the two aims of the study, I conducted two separate analyses. For both analyses, the unit of analysis was the workplace rather than an individual victim or perpetrator.

#### *3.3.1. Occupational Homicide Case Series*

For the case series of occupational homicides occurring in North Carolina, I computed the frequency and percentage of cases assigned to robbery and non-robbery



motives. Cases were further stratified by type (1, 2, 20), and the distribution of cases to each of these categories is reported. I also present a case study for each of the four event types for both robbery- and non-robbery-related homicides.

Other descriptive statistics characterizing the events with regard to the perpetrator's relationship to the victim and/or workplace, the industries in which these crimes occurred, weaponry used during the infliction of the fatal injury, and the day and time of the assaults were also calculated and reported by motive and type.

A chi-square analysis was performed to test for differences between robbery and non-robbery events with regard to event type (Type I, Type II, Type III, or Type IV), time of event (night versus day), industrial sector (construction; manufacturing; transportation and utilities; wholesale trade; retail; insurance, real estate, and finance; service; and public administration), and weapon (firearm, sharp instrument, blunt force, and/or bodily force). When expected cell counts were  $\leq 5$ , I used Fisher's exact test.

### *3.3.2. Examination of Workplace Violence Prevention Strategies*

The second analysis compared case workplaces to control workplaces. Case workplaces were those that experienced a non-robbery-related workplace homicide committed by a perpetrator with a prior relationship with the workplace or at least one of its employees (prior-relationship homicide) in North Carolina from January 1, 1994 through December 31, 2003. I utilized all of the controls from *A North Carolina Study of Workplace Homicide*, matched to the cases (occurring January 1, 1994 – March 31, 1998) in that study by calendar time (control workplace was in operation during the month in which the homicide occurred) and industrial sector (single-digit SIC code), for this

comparison (31, 64). The aim of this analysis was to examine the association between recommended workplace violence prevention strategies and prior-relationship homicides.

#### 3.3.2.1. Key Variables

The following discussion illustrates the way in which analysis variables were created. An outcome variable representing case status for the cases and controls was created. I also constructed exposure variables representing each proposed strategy and a group of potentially confounding variables from the questionnaire data. Because this research utilized, in large part, secondary data, some NIOSH recommendations could not be examined at all and the data for others may not adequately reflect some of the recommendations. Variables were constructed to best describe the condition and policies of the workplace in terms of those recommendations. I selected the covariates to explore as potential confounders a priori based on findings from previous studies and the data available from the questionnaire.

#### *Outcome – Workplace homicide*

The outcome of interest is the odds of prior-relationship homicide. To estimate the odds of homicide, a group of workplaces, identified by the occurrence of a prior-relationship, was assembled. For each case workplace, I assigned a value of one to a variable representing case status, and for each control workplace, I assigned a value of zero to that same variable.

*Exposure – Environmental attributes: Physical Separation of Workers from Customers, Clients, and the General Public*

The National Institute for Occupational Safety and Health suggests that in retail settings physical separation between employees and their clients or the general public may prevent workplace violence (65). The questionnaire administered to the workplace managers queried the types of physical barriers present in the workplace. First, managers were asked how often transactions were done in cash at the workplace (questionnaire element number 120, Q120). If the manager responded “all of the time”, “most of the time”, or “some of the time”, he or she was then asked about physical barriers separating employees from clients and the general public. The variable derived from the following questionnaire element was used for the analysis: “Q121: Was there usually a counter or other barrier between employees and customers when exchanging cash?”. If the manager responded “yes”, I assigned a value of one to the barrier variable. Conversely, if the manager responded “no”, I assigned a value of zero to the barrier variable. Had the manager withheld a response for any reason, the variable was not assigned a value and remained missing throughout the analysis.

*Exposure – Environmental attributes: External visibility of employees and external lighting*

NIOSH also recommends for employers to improve the visibility of their workers from the exterior of the workplace as well as exterior lighting, and managers were asked questions during the administration of the questionnaire regarding both visibility and lighting (65). Managers were asked whether their employees could be seen from outside

the workplace (Q33), and the possible responses were “yes” and “no”. Likewise, managers were asked about the quality of the lighting on the outside of the building (Q30). Respondents were given as possible responses very bright, somewhat bright, dim, or there is no lighting on the outside of the building. For both questions, the respondent may have refused to complete the instrument element, might not have known the condition of the visibility or the lighting, or may have just failed to complete the item. Variables representing lighting and visibility were constructed from these two elements.

If the respondent answered “yes” to the visibility question, I assigned a value of one to the visibility variable, and for responses of “no”, I assigned a value of zero to the visibility variable. All other responses received a missing value for this variable. For responses of “very bright” and “somewhat bright” to question thirty, a variable describing exterior lighting was given a value of one, and for responses of dim or no lighting, the value zero was assigned. For all other responses, the exterior lighting variable was also assigned a missing value.

*Exposure – Environmental attributes: Access to and egress from the workplace*

The next environmental characteristic of the workplace to be examined was access to and egress from the workplace. NIOSH suggests that the number of entrances and exits to the workplace, the ease with which non-employees can access work areas due to unlocked doors, and the number of areas where potential attackers might hide affect the risk of workplace violence (65). Although the questionnaire did not query managers about the number of entrances and exits in the workplace, they were asked about entrances open to the public during regular business hours as well as before and

after business hours. Thus, these questions pertaining to public entrances were utilized in the analysis. In addition, a number of questions pertaining to ease of access to the workplace were asked of managers, although no information was gathered about potential hiding places. The questionnaire elements from which variables were derived as well as the values for those variables are shown in Table 3.2.

Summary variables were then created from these individual variables. A variable representing locked entrances was assigned a value of one if either the workplace kept their entrances closed to the public after hours or entrances were kept locked during work hours. I assigned this locked entrances variable a value of zero if entrances were neither kept closed after hours nor locked during work hours. If the manager reported keeping entrances open after hours or during the work shift and did not complete the other question, or the manager did not complete either question, I left the value for the locked entrances variable missing for the analysis.

In addition, a variable representing the use of any of the access restricting policies, i.e. using swipe cards, wearing identification badges, requiring sign-in procedures for visitors, and displaying signs restricting access to certain work areas, was created. If a manager reported use of at least one of these policies, I assigned a value of one to the access restricting summary variable, and if a manager reported using none of these four policies, I assigned a value of zero to the variable. If none of these policies were reported, but any of the variable values for these four individual policies was left missing for the previously created variables, the summary variable value was also left missing.

A summary variable was also created to which a value of one was assigned if either of the access summary variables described above had a value of one, and a value of

zero was assigned if both access summary variables described above had values of zero. If the value for either of the summary variables was missing and the other had a value of zero, this summary variable was not assigned a value. The locked entrances variable and the access restricting summary variable as well as their summary variable were used for the final analysis rather than the six component variables used to create them. However, univariate results for these six component variables are shown in Appendix E.

*Exposure – Environmental attributes: Use of security devices*

The NIOSH recommendations also suggest the utilization of security devices as a means to both prevent workplace violence and as a tool for the identification and apprehension of a perpetrator once a crime has been committed (65). Thus, variables were created to represent the implementation of this recommendation in the workplace. Those questionnaire elements from which the security device variables were created are shown in Table 3.3 with the possible responses to each question.

A variable was created to represent the presence of either alarms used to alert law enforcement of a problem in the workplace or mirrors used for security purposes or to observe customers. For this alarms and/or mirrors variable, the variable was coded one if either or both of these devices were employed in the workplace. If, however, neither of these devices was reported, the new variable was assigned a value of zero. In the case in which either mirrors or alarms were reported not to be used and either one or both of these questions was not completed for any reason, the new alarm and/or mirror variable was not assigned any value.

Finally, a summary variable was created for which a value of one was assigned if the respondent reported “yes” to any one of the questions regarding security camera, alarms, mirrors, or any other security device. If the response to all of the questions shown in Table 3.3 were “no”, I coded the new variable zero. Finally, for workplaces in which no security devices were reported and for which at least one of the questions had a response other than “yes” or “no”, the summary security device variable was not assigned a value. This variable for at least one security device being used in the workplace was used for the final analysis. However, univariate results for the component variables and the mirror-alarm summary variable are also shown in Appendix E.

*Exposure – Administrative policies: Staffing plans*

Although a variety of staffing plans and work practices are outlined in the guidelines published by NIOSH, only three were evaluated for this dissertation due to the data available from the questionnaire (65). These guidelines suggest using both security guards and receptionists at the entrance to workplaces, and the survey instrument asked questions about whether such employees were stationed in these areas. For workplaces in which managers responded “yes” to the question “During the hours when employees were routinely working, were there usually security guards at any of the entrances?”, the guard variable was assigned a value of one. If the manager responded “no” to this question, I assigned a value of zero to the variable. For workplaces in which the respondent did not provide an answer to the question, I left the value for this variable missing. Similarly, when managers responded “yes” to the question “During the hours when employees were routinely working, were there usually receptionists at the

entrances?”, I assigned a value of one to the receptionist variable, and when they responded “no” to that question, I assigned the value of zero. When the respondent did not provide an answer to the question for any reason, the variable was not assigned a value.

In addition to using security guards and receptionists to screen visitors and control access to work areas of the workplace, the NIOSH recommendations suggest increasing staffing levels. During the survey, managers were asked if employees ever worked alone. Thus, the study examined whether working alone might increase the risk of workplace homicide. The variable created for use in this analysis was derived from the following question: “Did any workers ever work alone?”. For workplaces in which employees were reported to ever work alone, I assigned the new variable a value of one, and when managers reported employees never worked alone, I assigned the variable a value of zero. If the manager did not complete the question for any reason or did not know whether workers ever worked along, I did not assign a value to this variable.

A summary variable for these staffing practices was also created to which a value of one was assigned if the manager reported stationing a security guard or receptionist at the entrance of the workplace or reported that workers never work alone. If the manager reported no security guard at the entrance, no receptionist at the entrance, and that employees ever worked alone, I assigned a value of zero to the summary variable. If none of these staffing practices was reported and at least one of them was not completed, I did not assign a value to the summary variable.



*Exposure – Administrative policies: Employee training regarding workplace violence prevention*

Several questionnaire elements address employee training opportunities. All of these training variables were coded dichotomously by assigning values for the analysis variables as shown in Table 3.4. A summary variable was also created in which a value of one was assigned for any workplace for which the variables shown in Table 3.4 were coded one. If all of the responses to the questions shown in Table 3.4 were “no”, I assigned a value of zero to the summary training variable. If, however, none of the questions received a response of “yes” and some or all of the questions received a “no” response, I did not assign a value to the summary variable.

*Potential confounder – Hours of operation*

Hours of operation was assessed as a confounder of the prevention strategies and odds of prior-relationship homicide associations. During the administration of the questionnaire, managers were asked about both the hours that the workplace was open to the public as well as about the usual operating hours of the workplace, i.e. the hours during which employees are in the workplace. Using responses to these questions, several analysis variables were created to represent times at which employees could be found in the workplace. For each of the variables created, I assigned a value of one to the new variable if employees were present at the time indicated by that variable, and I assigned a value of zero to that variable if no employees were present at the time indicated for that variable. The times represented by this set of analysis variables are

shown in Table 3.5. When respondents were unaware of the times at which employees were present at the workplace, these variables were not assigned values.

*Potential confounder – Contact with the public*

In addition to the hours during which employees are present at the workplace, contact with the public was assessed as a confounder of the prevention strategies and odds of prior-relationship homicide associations. Although no questionnaire element asked directly about contact with the public, question 81 of the instrument asked if the workplace was ever open to the public. I used being open to the public as a proxy measure of contact with the public, and for respondents who reported that the workplace was open to the public, I assigned a value of one to the public contact variable. For those respondents reporting that the workplace was not open to the public, I assigned a value of zero to the public contact variable. Finally, for those workplaces for which the respondent would not or could not provide an answer to this question, no value was assigned to the variable.

*Potential confounder – Workplace size in terms of employees*

Workplace size was also assessed as a potential confounder. I utilized two elements from the questionnaire to compute the total number of workers employed by the workplace at the time of the case homicide: “What was the total number of male employees who worked at your business?” and “What was the total number of female employees?”. For the workplaces where estimates were provided for both questions, the responses from these questions were combined for the total number of employees. When

a respondent could not provide an estimate of the number of workers for both questions, no value was assigned to this interim variable. Once the interim variable representing total workers was constructed, the median value of this variable for the entire study population was calculated. Based on this median value, a dichotomous analysis variable was constructed where workplaces with seven or fewer total employees were assigned a value of one representing a small workplace, and workplaces with more than seven employees were assigned a value of zero representing a workplace that was not small. For workplaces where a value was not assigned to the interim numeric variable, a value was not assigned to the small workplace variable.

A second variable representing workplace size in terms of the number of employees was also created reflective of the Occupational Safety and Health Administration definition of small workplaces for regulatory and enforcement functions: workplaces with ten or fewer employees. I used the same interim numeric variable described above to assign values: workplaces with ten or fewer reported employees were assigned a value of one, and workplaces with more than ten reported employees were assigned a value of zero. For workplaces with no available data, I left the value for the variable missing.

#### *Potential confounder – Time at location*

The time the workplace had been at the location when the index homicide occurred was also assessed as a potential confounder. During the administration of the questionnaire, respondents were asked "... how many years has your business been at its current location?", and responses were coded less than six months, six to eleven months,

one to two years, 3 to 5 years, or more than five years. Using this element of the questionnaire, I created an analysis variable to which I assigned a value of one for those workplaces reporting to be in their location for two or fewer years and a value of zero to those workplaces reporting to be in their location for more than two years. When respondents did not provide an answer to this question, a value was not assigned to the analysis variable.

*Potential confounder – Type of location*

The type of location in which the workplace was located, e.g. whether the workplace was located in an area zoned commercial or residential, was assessed as a potential confounder. The questionnaire queried respondents on whether the workplace was located in an area that could be described as any one or more of these types of locations: an enclosed shopping mall, a non-enclosed strip shopping center, a business or commercial district, a residential area, an industrial park or area, and a rural area. For each of these types of locations, I created a dichotomous analysis variable to which a positive response was assigned a value of one and a negative response was assigned a value of zero. For any location for which the respondent did not provide an answer, the value of the analysis variable did not receive a value.

*Potential confounder – Race and ethnicity of work staff*

The final characteristic of the workplace to be assessed as a potential confounder was the racial and ethnic composition of the workforce. The survey instrument asked questions about the number of employees at the time of the index homicide that could be

classified as white, black, or Asian race as well as Hispanic ethnicity. An open-ended question asking about any other racial or ethnic groups being represented was also posed. From these questions, several analysis variables representing the racial and ethnic composition of the workforce were created. For workplaces in which no employees were reported to be of black race, Asian race, Hispanic ethnicity, or any other racial/ethnic group, a variable representing an all-white workforce was assigned a value of one. If any employee belonging to any of these other classifications worked in the workplace, I assigned a value of zero to the variable. I also created a variable representing any black employees by assigning a value of one to any workplace in which at least one black employee was employed and a value of zero for any workplace not reporting any black employees. For workplaces whose managers did not report the racial composition of workforce, I did not assign a value to the variable. Analysis variables were also created to represent any Asian employees and any Hispanic employees in the same manner. Finally, an analysis variable was created where any workplace reporting any non-white employees was assigned a value of one, and workplaces reporting only white employees were assigned a value of zero. For all of these variables, if the respondent supplied no information about the racial and ethnic composition of the workforce, these variables were assigned no value.

### 3.3.2.2. Univariate Analysis

For the evaluation of prevention strategies, I first computed descriptive statistics to show the extent to which workplaces in North Carolina use these strategies and then performed Fisher's exact test to determine whether the distribution of the strategies

among the cases and controls differed significantly (66). Unadjusted odds ratios and corresponding exact 95% confidence intervals were then estimated for these strategies to determine the association between each strategy and the odds of prior-relationship homicide.

### 3.3.2.3. Assessment of Potential Confounders

Due to the limited sample size, several binary variables (described in greater detail in Section 3.3.2.1.) were created to represent potential confounding factors. These variables were selected a priori based on prior research findings and the available data from the questionnaire to determine whether they may be potential confounders. I narrowed the group of potential confounding factors to one variable per group by examining each covariate-outcome association. These odds ratios and corresponding 95% confidence intervals are shown in Appendix F. Based on whether any association was observed between each potential confounder and the outcome, possible confounders were narrowed to six of the analysis variables. These six potential confounders were:

- Having any night hours (employees were ever working at any time between 9:00 pm and 5:59 am versus employees never working between these times),
- Having contact with the public (ever open to the public versus never being open to the public),
- Being a small workplace (employing ten or fewer workers versus employing greater than ten employees),
- Being at the location at the time of the event for 2 years or less (at location 2 years or less versus at the location for more than 2 years),

- Being located in an industrial park (being located in an industrial park versus being located in any other type of areas such as a rural or urban area), and,
- Having minority employees (having at least one non-white or Hispanic employee versus having only non-Hispanic, white employees).

Once these potential confounders were identified, the odds ratios and their corresponding 95% confidence intervals quantifying the association between each of the potential confounding variables and all of the exposure variables were computed (shown in Appendices G through M). Multiple logistic regression models were fit utilizing forward selection to assess for the presence of confounding by each of the six potentially confounding variables. A criterion of 10% change between the unadjusted and adjusted estimates was used to determine the presence of appreciable confounding by a covariate (67). Because of the limited sample size, exact methods were utilized to estimate these odds ratios and 95% confidence intervals (68). This process was carried out separately for each of the prevention strategies. The results from these analyses are also shown in Appendices G through M.

Based on these results, five of the covariates often confounded the main effect between the exposures, the various prevention strategies, and the outcome, prior-relationship homicide. For ease of interpretation and presentation of findings, I controlled for the same set of these five confounders in all of the final models, shown in Section 5.3: night hours of operation (open any night some time from 9:00 pm and 5:59 am), small workplace size (10 or fewer employees), at current location two years or fewer, located in an industrial park, and having any minority employees (at least one African-American, Asian, or Hispanic employee).

#### 3.3.2.4. Examination of the Effect of History of Violence on the Strategy-Homicide Associations

The effect of reported violent events in the workplace in the two years prior to the month of the homicide was also explored. Previous studies have shown that a history of violence in a workplace is strongly associated with subsequent violence occurring in that workplace (33, 54). These workplaces may consequently adopt prevention strategies. Thus, history of violence acts as a preceding cause on the causal pathway and not as a confounder. Controlling for such a covariate may mask or dampen potentially protective effects of the exposure of interest (69). Thus, history of violence was examined during the analysis as a separate risk factor for prior-relationship homicide. By stratifying the exposure – outcome data by the reporting of any violent events in the two years prior to the month of the homicide, I examined whether the effect of a prevention strategy on the risk of prior-relationship homicide might be modified by a history of violence. These results, too, are shown in Appendices G through M. Unfortunately, cell counts were often equal to zero; insufficient sample size precluded fitting models with an interaction term to explore the modifying effect of history of violent events with a multivariate analysis.

#### 3.3.2.5. Sensitivity Analysis

To hypothetically correct for misclassification of exposure, I conducted a simple sensitivity analysis. The first portion of the analysis examined different levels of non-differential misclassification. Three different scenarios during which differential



misclassification of the exposure could have occurred were also explored in this sensitivity analysis. The analysis was conducted for the two prevention strategies for which I found an effect, which were keeping entrances locked when employees are present and the workplace is not open to the public and using at least one security device in the workplace. I present a more extensive discussion of possible sources of bias in this study as well as a more thorough description of the methods used during the sensitivity analysis in Appendix N. Corrected odds ratios and corresponding levels of sensitivity and specificity for both cases and controls are also shown in the tables in Appendix N.

#### 3.3.2.6. Controlling for Industrial Sector

Because the original controls were matched to cases by major *Standard Industrial Classification* code, I also explored the effect of controlling for industrial sector on the effect estimates. These results are shown in Appendix O.

### **3.4. Protection of Human Subjects**

Approval for the conduct of this study was sought and granted by the Public Health Institutional Review Board (IRB) at the University of North Carolina at Chapel Hill via expedited review. IRB renewal applications were subsequently filed and approved following initial application and approval for the entire duration of the study.

Care was taken during the course of the study to protect human subjects. Information was obtained about individually identifiable human subjects; however, these individuals are deceased, and NC OCME files are publicly available records. All information obtained regarding the victims of these events was maintained in paper files.

These paper files were stored in a locked filing cabinet at the investigator's personal residence or office during the course of the study and will be transferred to the locked filing cabinets currently storing the data from both *A North Carolina Study of Workplace Homicide* and *Homicide During Robbery: A Case-Control Study*. These data will continue to be stored and utilized by the Department of Epidemiology at the University of North Carolina at Chapel Hill upon completion of the dissertation.

Recruitment of subjects occurred through telephone interview. For these participants, contact information was obtained and stored in the paper files for each case workplace discussed earlier. Once informed consent was obtained and the subject participated in the questionnaire, the hard copy of the survey instrument was stored in the paper files as well. The data from the questionnaire, not including the respondent's contact information, were entered into an electronic database. These electronic data are stored in a password-protected computer accessed by only the investigator at her residence and in her office. At the completion of the study, these data will also be transferred to the Department of Epidemiology where they will be stored with data from the previously mentioned workplace violence studies on password-protected computers. These data do not contain any personal identifiers for the respondent. No compensation was offered for participation in the study.

Because the number of workplace homicides is relatively few and this phenomenon receives a great deal of media attention, deductive identification of workplaces with unique features is possible, although not probable. Data were collected at the level of the workplace. Detailed data regarding the particular circumstances of each event precipitating a workplace homicide were not and will not be presented, and

the other types of data collected and presented do not provide enough individual detail to allow deductive disclosure. Characteristics occurring in small enough numbers to identify specific workplaces and/or workplace managers will not be reported in any disseminated materials. Case studies are presented for illustrative purposes, but details from specific cases were not included. Caution was and will continue to be taken to avoid deductive disclosure of these workplaces.

Participation in the study may have been difficult for workplace managers from case workplaces, as they had to recall events surrounding a tragic event within their workplace. However, the study had benefits that outweighed the risks to participants. Participation in the study provided workplaces and workers in North Carolina with anticipated benefits. Findings from the study will help workplaces to better understand the phenomenon of workplace homicide and what interventions within the workplace can reduce the occurrence of these homicides as well as what interventions do not deter such violence both directly from the results to be disseminated to requesting participants and indirectly through policies potentially affected by the results. In addition, future research stimulated by these findings will serve to benefit this working community further.

Table 3.1. Studies during which data were collected and activities completed during each phase of data collection for the dissertation research.

	Data Collection Activities Necessary for the Conduct of Dissertation Research	Definition of a Case
<i>A North Carolina Study of Workplace Homicide</i>	<ul style="list-style-type: none"> <li>▪ Homicide review conducted for deaths occurring 01.01.1994 – 03.31.1998</li> <li>▪ List of occupational homicides enumerated</li> <li>▪ Case ascertainment completed for all occupational homicides occurring January 1, 1994 – March 31, 1998</li> <li>▪ Questionnaire administered to all qualifying case workplace managers occurring January 1, 1994 – March, 31, 1998</li> <li>▪ Questionnaire administered to control workplace managers</li> </ul>	All workplaces experiencing an occupational homicide 01.01.1994 – 03.31.1998 (exclusions included workplaces classified as agriculture, police protection, and national security)
<i>Homicide During Robbery: A Case-Control Study</i>	<ul style="list-style-type: none"> <li>▪ Homicide review continued through December 31, 2000</li> <li>▪ List of occupational homicides enumerated April 1, 1998 – December 31, 2000</li> <li>▪ Case ascertainment completed for all robbery-related workplace homicides</li> </ul>	All workplaces experiencing a robbery-related occupational homicide January 1, 1994 – December 31, 2000 (Exclusions included workplaces classified as agriculture, police protection, and national security)
RQ1: Case series	<ul style="list-style-type: none"> <li>▪ Homicide review continued through December 31, 2003</li> <li>▪ List of occupational homicides enumerated January 1, 2001 – December 31, 2003</li> <li>▪ Case ascertainment completed for all non-robbery-related occupational homicides March 1, 1998 – December 31, 2000</li> <li>▪ Case ascertainment completed for all occupational homicides January 1, 2001 – December 31, 2003</li> </ul>	All workplaces experiencing an occupational homicide January 1, 1994 – December 31, 2003

	Data Collection Activities Necessary for the Conduct of Dissertation Research	Definition of a Case
RQ2: Evaluation of Prevention Strategies	<ul style="list-style-type: none"> <li>▪ Questionnaire administered to all qualifying case workplace managers occurring April 1, 1998 – December 31, 2003</li> </ul>	All workplaces experiencing a Type II, Type III, and Type IV non-robbery-related workplace homicide January 1, 1994 – December 31, 2003

Table 3.2. Questionnaire elements from which workplace access variables were created, possible responses, and values for the new variables.

Questionnaire Elements	Responses	Value
Q38. And when employees were working before or after regular business hours, were there any entrances open to the public?	No	1
	Yes	0
	Employees did not work outside of regular business hours	1
	Not completed, Refused, Don't know	
Q39. During the hours when employees were routinely working, were there usually unlocked entrances?	No	0
	Yes	1
	Not completed, Refused, Don't know	
Q42. During the hours when employees were routinely working, were there usually employees using magnetic swipe cards for gaining access during working hours?	No	0
	Yes	1
	Not completed, Refused, Don't know	
Q43. During the hours when employees were routinely working, were there usually ID badges worn by employees?	No	0
	Yes	1
	Not completed, Refused, Don't know	
Q44. During the hours when employees were routinely working, were there usually sign-in procedures for visitors?	No	0
	Yes	1
	Not completed, Refused, Don't know	
Q45. During the hours when employees were routinely working, were there usually signs telling visitors not to enter certain areas?	No	0
	Yes	1
	Not completed, Refused, Don't know	

Table 3.3. Questionnaire elements from which security device variables were created, possible responses, and values for those new variables.

Questionnaire Elements	Responses	Value
Q58. Did your business use video surveillance cameras?	No	0
	Yes	1
	Yes, not in working order	1
	Not completed, refused, don't know	
Q58. Did your business use video surveillance cameras?	No	0
	Yes	1
	Yes, not in working order	0
	Not completed, refused, don't know	
Q61. Did your business have any kind of alarm system for a worker to alert police or security guards that someone was in danger?	No	0
	Yes	1
	Not completed, refused, don't know	
Q63. Were there any mirrors used for security purposes or for observing customers?	No	0
	Yes	1
	Not completed, refused, don't know	
Q64. Were there any other kinds of security systems or procedures that your business used besides the ones I've mentioned?	No	0
	Yes	1
	Not completed, refused, don't know	

Table 3.4. Questionnaire elements from which workplace training variables were created, possible responses, and values for the new variables.

Questionnaire Elements	Responses	Value
Q66. Did your business offer safety training, or discuss safety with each employee, regarding how to avoid being attacked in parking lots or while going to and from work?	No	0
	Yes	1
	Not completed, refused, don't know	
Q67. Did your business offer safety training, or discuss safety with each employee, regarding how to respond to hostile or threatening coworkers?	No	0
	Yes	1
	Not completed, refused, don't know	
Q68. Did your business offer safety training, or discuss safety with each employee, regarding how to respond to hostile or threatening customers and clients?	No	0
	Yes	1
	Not completed, refused, don't know	
Q69. Did your business offer safety training, or discuss safety with each employee, regarding self-defense?	No	0
	Yes	1
	Not completed, refused, don't know	



Table 3.5. Values for analysis variables created for days and hours during which employees were present in the workplace.

Employees present	Specific days and times*	Value
Days only	Any day(s), 7:00 am to 5:59 pm only	1
	Any day(s), 6:00 pm – 6:59 am	0
Any evening hours	Any day(s), any time 6:00 pm – 8:59 pm	1
	Never between 6:00 pm – 8:59 pm	0
Any night hours	Any day(s), 9:00 pm – 6:59 am	1
	No hours 9:00 pm and 5:59 am	0
Monday – Friday only	Monday through Friday only, any time	1
	Any hours Saturday or Sunday	0
Any Saturday hours	Any time, Saturday	1
	No Saturday hours	0
Any Sunday hours	Any time, Sunday	1
	No Sunday hours	0
Any weekend hours	Any time, Saturday or Sunday	1
	No weekend hours	0
Friday night hours	Friday, 9:00 pm – Saturday, 5:59 am	1
	No Friday night hours	0
Saturday night hours	Saturday, 9:00 pm – Sunday, 5:59 am	1
	No Saturday night hours	0
Evening and weekend hours	Evening and weekend hours per above	1
	No evening or weekend hours	0
Night and weekend hours	Night and weekend hours per above	1
	No night or weekend hours	0
Open 24 hours at least one day	Open for 24 hours at least once a week	1
	Closes for a portion of every day	0
Open 24 hours all 7 days	At least one employee always present	1
	Ever closes	0

\* Any portion of the time qualifies for inclusion in that category, e.g. a business open one night of the week from 9:00 pm – 10:00 pm was considered to have night hours.

## CHAPTER 4

### CONTRASTING ROBBERY-RELATED AND NON-ROBBERY-RELATED WORKPLACE HOMICIDES, NC, 1994 – 2003<sup>1</sup>

#### 4.1. Introduction

Violence has garnered increasing attention in recent decades. The World Health Organization has recognized an increase in intentional injuries throughout the world, and identified violence as an international public health problem (3). Leading the developed world in firearm violence, Americans are among the most likely to sustain these types of injuries (4). In the US, homicide is one of the leading causes of death for people under the age of 45, and the workplace is an important venue in which violent crime occurs (5, 6).

Americans spend a great deal of time in the workplace, and violence accounts for a notable portion of fatal and nonfatal injury at work (70, 71). Violence is the second leading cause of fatal occupational injury among women and the fourth leading cause of such deaths among men (6). Consequently, a need exists for epidemiologic studies characterizing the circumstances of workplace violence (22).

As part of a comprehensive approach to develop prevention strategies aimed at reducing workplace violence, the California Department of Industrial Relations developed a way to categorize workplace violence based on the motives of perpetrators

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<sup>1</sup> NOTE: Submitted to the American Journal of Preventive Medicine. Authors were Kelly K. Gurka, Stephen W. Marshall, Carol W. Runyan, Dana P. Loomis, Carri Casteel, and David B. Richardson.

(1, 20). Type I violence is committed by a perpetrator having no prior relationship with the workplace or its employees, who enters the workplace with intent to perpetrate a criminal act. Type II violence occurs when a recipient of legitimate services assaults an employee, e.g. patients attacking healthcare providers or inmates assaulting correctional personnel. Violent acts perpetrated by persons associated with the workplace as employees or known to employees through a personal relationship are categorized as Type III. This initial typology was subsequently expanded by subdividing Type III events such that violence perpetrated by past or current employees is classified as Type III and events involving perpetrators known personally to an employee such as by friendship or intimate partnership are Type IV (2).

Research on workplace homicides has largely focused on robbery-related violence (18, 34-40). Less is known about non-robbery-related workplace homicide. I describe epidemiologically occupational homicides in North Carolina in the years 1994 - 2003, comparing robbery- and non-robbery-related incidents. In order to achieve this goal, I applied an expanded typology of workplace violence, which includes robbery as a motive.

## **4.2. Methods**

We reviewed all North Carolina Medical Examiner (ME) cases with manner of death indicated as homicide occurring from 1994 to 2003. To identify any cases that could be work-related, we included all victims at least 10 years of age. North Carolina law requires that all deaths resulting from injury be investigated by an ME and that a report be filed in the Office of the Chief Medical Examiner (NC OCME). We obtained a list of these deaths from the NC OCME and reviewed each medical examiner report

(MER) and death certificate for information about location of onset of fatal injury. Cases qualified for inclusion when the fatal injury occurred at work in NC and death resulted within 365 days. *Operational Guidelines For Determination of Injury at Work*, developed and disseminated by the Association for Vital Records and Health Statistics (now the National Association for Public Health Statistics and Information Systems), the National Institute for Occupational Safety and Health, the National Center for Health Statistics, and the National Center for Environmental Health, were applied (61). These were developed in 1992 to create criteria by which to judge whether a fatal event was work-related (72).

We abstracted NC OCME records for fatal injuries occurring at work and those that might have occurred at work (based on information in the record). If a record contained information suggesting a victim may have been at work at the time of injury, but not enough to make this determination with confidence, we interviewed law enforcement officers who investigated the homicide. For cases in which the law enforcement agency was unwilling to participate, we consulted newspaper accounts. Based on information from these sources, we classified questionable homicides by on-the-job status.

The workplace was the unit of analysis. Single events resulting in multiple homicides were included only once. Homicides involving workplaces classified as police protection or national security were excluded (64).

I classified each homicide by the perpetrator's motive and relationship to the workplace or its employees:

1. Motive. Homicides for which the motive was robbery or strongly suspected by law enforcement to be robbery versus cases in which robbery was known not to be the motive.
2. Event type. Events were assigned to Type I, Type II, Type III, or Type IV.

When multiple motives were mentioned, the primary motive for the crime, in the opinion of the law enforcement officer, was utilized for classification. For example, if a perpetrator's primary intent was judged to be to assault an estranged partner, but the perpetrator also stole money when exiting the workplace, motive was classified as non-robbery. If the event could be assigned to multiple typology categories, I assigned the case to only one category, the one thought to have greater influence on the homicide occurring at that particular time and place, though both relationships with the workplace or its employees likely influenced the motivation for committing the homicide.

For events in which the presumed purpose for the perpetrator going to the workplace was solely criminal intent, and no prior relationship existed between the perpetrator and the workplace or its employees, the event was classified as Type I. For robberies, this included events in which the perpetrator posed as a customer. I assigned events for which victims appeared to be selected at random to Type I, e.g. if no relationship between the perpetrator and victim was identified following a drive-by shooting, I classified the case as non-robbery Type I.

Data collected included information regarding weaponry and the time, day, and month of onset of injury. Workplaces were classified by *Standard Industrial Classification*: agriculture (A), mining (B), construction (C), manufacturing (D),

transportation, communication, and utilities (E), wholesale trade (F), retail (G), finance, insurance, and real estate (H), services (I), and public administration (J) (64).

I tabulated frequencies and conducted chi-square analyses to test for differences between robbery and non-robbery homicides. When expected cell counts were  $\leq 5$ , I used Fisher's exact test (66). When the chi-square statistic was not valid due to small cell counts, but computational time and memory necessary for exact methods was substantial due to large numbers of table rows and columns, I computed Monte Carlo estimates of the exact p-value (73). All analyses were performed in SAS Version 9.1 (SAS Institute, Inc., Cary, NC, 2002-2003).

### **4.3. Results**

We reviewed 7128 homicides and identified 269 events meeting the inclusion criteria. I excluded 20 events involving law enforcement agents and five in the military. Of those events included in the case series, 169 (63%) appeared to be motivated by robbery, and 96 (36%) were not. I could not classify motive for four homicides.

Robbery-related and non-robbery-related homicides were classified by type (Table 4.1). For 18% (31 / 170) of the robbery-related homicides, I was unable to identify the perpetrator's relationship to the workplace and therefore could not classify them by workplace violence typology. However, I identified the suspect's relationship to the workplace for all non-robbery-related homicides. Eleven cases could have been assigned to more than one category of workplace violence, indicating the categories of this typology are not mutually exclusive. I used the approach described in the methods to classify these homicides into one category. For example, a perpetrator who was both a

sibling and co-worker of the victim could be classified as both Type III and Type IV. For the analysis, such a case was assigned to Type III because the co-worker relationship is what brought the perpetrator and victim into the same environment in which the homicide was committed. Table 4.2 shows these events by categories to which they could be assigned and were assigned for analysis.

As shown in Table 4.1, the relationship of the perpetrator to the workplace and its employees differed significantly ( $p < 0.01$ ) between robbery-related and non-robbery-related homicides. Strangers committed over 70% of the robbery-related homicides. In contrast, 89% of the non-robbery-related homicides involved perpetrators having a relationship with the workplace or an employee.

Though robbery-related homicides are typically described as Type I events, 9% of robbery-related homicides were classified as Type II, Type III, or Type IV in this study, and 11% of non-robbery-related homicides were classified as Type I. Table 4.3 provides scenarios for non-robbery-related, Type I homicides as well as robbery-related homicides classified as Type II, Type III, or Type IV.

Committing only 1% of the 169 robbery-related homicides, customers of the business perpetrated 27% of the non-robbery-related homicides (Table 4.1). These incidents occurred most frequently in the retail ( $n = 10$ ) and service ( $n = 10$ ) industries. Homicides also occurred in real estate ( $n = 4$ ), manufacturing ( $n = 1$ ), and transportation ( $n = 1$ ). For Type II homicides, employees were most often ( $n = 10$ ) fatally injured trying to break up an altercation or removing a customer from the business.

Table 4.4 describes Type III and Type IV homicides. Of the twelve Type III robbery-related homicides, one involved two perpetrators (one current and one former

employee) and was excluded from this analysis. Among the remaining Type III homicides, the perpetrator's employment status differed significantly (exact  $p = 0.04$ ) between robbery- and non-robbery-related incidents: among non-robbery-related Type III homicides, nearly 85% of perpetrators were currently employed at the workplace, while current employees perpetrated 45% of robbery-related Type III homicides (Table 4.4).

Intimate partners committed the majority (85%) of the non-robbery-related Type IV homicides (Table 4.4). Other relationships classified as non-robbery-related Type IV included family members ( $n = 1$ ) or close personal relations ( $n = 4$ ) such as friends and former employers. In the one robbery-related Type IV homicide, the perpetrator was a familial relation of the victim.

Industrial sectors affected by occupational homicide differ significantly (exact  $p < 0.01$ ) by the four combined categories of robbery and typology as shown in Table 4.5. The majority of robbery-related homicides occurred in retail (Type I: 67%, Type II, Type III, and Type IV: 71%) and transportation (Type I: 20%, Type II, Type III, and Type IV: 14%), whereas non-robbery-related homicides were distributed across all industries with concentrations in the retail (Type I: 45%, Type II, Type III, and Type IV: 26%), service (Type I: 18%; Type II, Type III, and Type IV: 27%), and manufacturing (Type I: 0%, Type II, Type III, and Type IV: 25%) sectors.

The weapon most commonly used to inflict injury during all of these homicides, as shown in Table 4.5, was a firearm. Non-robbery-related homicides (Type I: 91%, Type II, Type III, and Type IV: 87%) were more likely to be perpetrated with a gun than robbery-related homicides (Type I: 81%, Type II, Type III, and Type IV: 79%), but the



overall difference between the categories was not significant (exact  $p = 0.62$ ). For homicides in which type of firearm and typology is known (61%), handguns (74% overall) were most common (Table 4.6). Although choice of firearm did not differ significantly between robbery and non-robbery homicides ( $p = 0.07$ ), it did vary significantly across the workplace violence types (exact  $p = 0.02$ ) (Table 4.6). This difference is driven by the Type III homicides in which only 50% were perpetrated with a handgun compared to 83%, 71%, and 76% of Type I, Type II, and Type IV events, respectively.

For homicides when time of onset of injury was known (247/269, 92%), Type I robbery; Type II, Type III, and Type IV robbery; and Type II, Type III, and Type IV non-robbery homicides were more likely to occur at night, i.e. 9:00 pm – 5:59 am (70%, 58%, and 62%, respectively). The proportion of homicides occurring during the weekend (defined as 6:00 pm Friday to 5:59 am Monday) was greatest for Type I non-robbery-related homicides (50%) compared to the other three groups (Type I robbery – 29%; Type II, Type III, and Type IV robbery – 36%; and Type II, Type III, and Type IV non-robbery – 34%). The days of week when the categories of homicide occurred are shown in Figure 4.1, and months of year in Figure 4.2.

#### **4.4. Discussion**

I demonstrate that non-robbery-related homicides comprise a meaningful fraction of occupational homicides, and non-robbery- and robbery-related homicides are distributed differently across violence typology and industry. Thus, it may be useful to incorporate considerations of motive into the current workplace violence typology.

The workplace violence typology has been suggested to focus research and intervention development (1, 2, 20). However, the current system does not include mutually exclusive categories, and a high level of diversity can exist within each category. Both pose a challenge for developing comprehensive interventions. Approaches aimed at homicide as a whole may be effective for only a portion of those events, making program development and evaluation more difficult.

Robberies have been the most studied event during which occupational homicides occur, and the kind for which most intervention strategies have been assessed (32-40). I have demonstrated, however, that homicides in which the perpetrator entered the workplace only for criminal intent do not always involve robbery, and that robbery can motivate homicides for which the perpetrator has a relationship with the workplace or its employees. Although most robbery-related homicides in this series were Type I events, 10% were classified as Type II, Type III, or Type IV because the perpetrator had a relationship with the workplace or its employees. Because robbers probably target the workplace and not its employees specifically, victim (in this case, the workplace) selection is likely influenced by this prior connection. This distinction may be important when developing and evaluating prevention strategies. Because those committing Type II, Type III, or Type IV robbery-related homicides may have increased knowledge of the workplace compared to other perpetrators, prevention methods for these robberies may need to consider factors associated with familiarity with the workplace.

The study demonstrates the difference in the proportion of perpetrators who are strangers to the workplace and its employees. Non-robbery-related homicides were more likely to be committed by perpetrators with a personal relationship with the workplace or

its employees. It is less likely that strategies motivated by loss prevention such as cash handling procedures would deter events such as interpersonal conflicts from occurring (74). However, other strategies aimed at reducing robberies, such as access control or visibility and lighting, may afford protection against homicides perpetrated by known perpetrators.

By employing robbery-prevention strategies, assaults committed by customers of the workplace may be reduced. However, factors contributing to robbery deterrence may be ineffective at preventing unpremeditated events fueled by conflict over service or products. Recent recommendations have been made specific to preventing homicides perpetrated by customers including adequate staffing to meet customer needs and training for predicting and responding to conflict and escalation to violence (74).

I found current or former employees perpetrated only 10% (26 / 269) of non-robbery-related homicides. This contrasts with the popular image of occupational homicide stemming from disgruntled former employees exacting revenge (the “going postal” scenario often covered extensively by the news media). Current employees committed the majority (84%) of non-robbery-related Type III homicide. Because this group of perpetrators already have access to the workplace, most previously recommended environmental violence prevention strategies are likely ineffective (26). Currently recommended strategies aimed at Type III violence include screening potential employees, employee training regarding company violence definitions and policies, processes for terminating employees, and comprehensive reporting of both acts and threats of violence (26, 74).

Despite perpetrators of Type IV violence potentially having increased knowledge of the workplace compared to a stranger robber, strategies aimed at preventing robberies such as access control and security devices may also be effective at reducing the risk of homicides resulting from intimate partner violence (26). Newly recommended strategies include policies and training programs aimed at increasing the workforce understanding of intimate partner violence and the willingness of employees to disclose such violence to management (74).

Because they have gone largely unevaluated, particularly for non-robbery-related violence, both previously recommended and recently updated strategies for reducing each specific type of homicide need examination, including barriers to implementing them.

Not only do occupational homicides occurring during robbery and unrelated to robbery differ by perpetrator, but these events also differ by industry. In general, industries susceptible to occupational homicide include transportation, retail, and service (71). Robbery-related homicides largely drive these trends with most robbery-related homicides perpetrated against workplaces in the retail sector followed distantly by transportation. Non-robbery-related homicides were most likely to occur in the retail, service, and manufacturing industries. However, every major industry division experienced at least one non-robbery-related homicide over the study period. Thus, all workplaces would likely benefit from risk assessment determining the type of violence to which they are most susceptible and interventions targeting those types of violence.

Consistent with other homicides in the US, firearms play a prominent role in the perpetration of occupational homicides (4). This study demonstrates this, for firearms were used most often in all homicides regardless of robbery motive and the perpetrator's

relationship with the workplace or its employees. Although policies allowing firearms in the workplace have been examined, other workplace strategies to address firearm violence (e.g., metal detectors) are not well evaluated and need more careful study until widespread public policy effectively alters the presence of firearms in society (75).

Despite efforts to assemble a complete case series, cases may have been missed. Our method for identifying occupational homicides, however, minimized this possibility. Death certificates are typically the best single source for identifying fatal occupational injuries (76). While homicides may be particularly underreported as work-related injuries on death certificates, we reviewed medical examiner records for all homicides occurring in the state to determine at-work status. All injury deaths occurring in NC require investigation by an ME. Therefore, these records capture most, if not all, homicides, and law enforcement officers provided additional contextual information regarding the event and perpetrators not available during the initial investigation (thus not reported in the MER).

Misclassification of motive and type are also possible limitations. Classification decisions were based on information provided by law enforcement, but supplemental information often could not be provided for cases not yet cleared by the legal system, more often affecting recent cases. Officers providing data, however, were cautious in providing information they felt to be speculative. Consequently, these data are likely reliable, but errors remain possible.

#### 4.4.1. Conclusions

I found that although homicide motivated by robbery typically constitutes Type I fatal violence, robbery motivation can overlap categories of workplace violence, and not all Type I homicides are motivated by robbery. Considerations about motive may improve homicide intervention development. I found that nearly 40% of occupational homicides were unrelated to robbery. Thus, prevention strategies developed in the context of preventing robbery-related homicides may not adequately address the conditions that lead to a large fraction of homicides in the workplace.

Table 4.1. North Carolina occupational homicides by robbery motive and the relationship of the perpetrator\* with the workplace or its employees, 1994 – 2003.

Type	Perpetrator's relationship to the business or its employees	Robbery Motive n (%)	Non-robbery Motive n (%)
I	Criminal intent - no legitimate relationship with the business or its employees	124 (73)	11 (12)
II	Customer or client of the business	1 (1)	26 (27)
III	Former or current employee of the business	12 (7)	25 (26)
IV	Personal relationship with an employee of the business	1 (1)	34 (35)
Total		169	96

\*Of the 269 total occupational homicides, motive could not be determined for four cases, and the relationship of the perpetrator was unknown for 31 (18%) of the robbery-motivated events.

Table 4.2. Workplace homicides for which multiple categories of the workplace violence typology applied and category assigned for analysis.

Number of Cases	Motive	Type I	Type II	Type III	Type IV	Final Assignment
1	Robbery			X	X	IV
1	Robbery		X		X	II
1	Non-robbery		X		X	II
8	Non-robbery			X	X	III



Table 4.3. Representative scenarios resulting in occupational homicide occurring in North Carolina, 1994 – 2003, by type.

Type	Robbery Motive	Non-robbery Motive
I	A perpetrator(s) selects a place of business to which he or she has no connection. With the intent to take cash from the establishment, the suspect robs the business and kills those employees present to prevent his or her identity from being revealed by the victim(s).	An employee performing his job is fatally injured during a random act of violence committed by a perpetrator with no relationship to either the workplace or the victim. The motive in the crime is not robbery and is unrelated to the work being performed. A specific example includes a drive-by shooting in which victim selection was random.
II	A customer enters a business and utilizes the services offered by the establishment. After a legitimate service has been provided to the customer, he or she commits a robbery in which an employee is fatally wounded.	A customer begins to behave in a way inconsistent with tolerable behavior as defined by the business management. Steps are taken to remove the customer from the premises and a dispute ensues between the employee and the patron being removed. The event escalates to the point at which the patron intentionally injures the employee fatally.
III	A former employee of the business, familiar with both the environmental layout and administrative practices of the business, robs his or her former employer and fatally wounds an employee in the process.	Two employees have a history of discord in the workplace. The tension escalates to the point where one employee inflicts a fatal injury upon the other.
IV	A friend of an employee of the business, having some knowledge of the business and its practices, targets the establishment. During the robbery, that on-duty employee is fatally injured.	An employee involved in an intimate relationship in which a dispute has occurred comes to the workplace to perform their job. The employee's partner, aware of their partner's working situation, waits in the parking lot for the employee to emerge from the workplace. The dispute continues in the parking lot escalating to a fatal injury being inflicted upon the employee.

Table 4.4. Identity of perpetrator for Type III and Type IV occupational homicides by robbery motive, North Carolina, 1994 – 2003.

	Robbery Motive n (%)	Non-robbery Motive n (%)
Type III homicides*		
Current employee	5 (45)	21 (84)
Former employee	6 (55)	4 (16)
Type IV homicides		
Intimate partner	0	29 (85)
Familial relation	1 (100)	1 (3)
Other	0	4 (12)

\*The robbery-related homicide involving two perpetrators, one current and one former employee, is excluded from these data.

Table 4.5. Select characteristics of occupational homicides by robbery motive and workplace violence typology (1, 2), North Carolina, 1994 – 2003.

	Robbery Type I n (%)	Robbery Types II – IV n (%)	Non-robbery Type I n (%)	Non-robbery Types II – IV n (%)	Total n	Exact p-value
<b>Industry (SIC code*)</b>						
Agriculture	0	0	0	5 (6)	5	< 0.01
Mining	0	0	1 (5)	0	1	
Construction	2 (2)	0	1 (5)	1 (1)	4	
Manufacturing	1 (1)	1 (7)	0	21 (25)	23	
Transportation, communication, utilities	24 (20)	2 (14)	1 (9)	3 (4)	30	
Wholesale trade	0	0	0	1 (1)	1	
Retail	83 (67)	10 (71)	5 (45)	22 (26)	120	
Finance, insurance, real estate	2 (2)	0	1 (9)	7 (8)	10	
Services	12 (10)	1 (7)	2 (18)	23 (27)	38	
Public administration	0	0	0	2 (2)	2	
<b>Weapon (Multiples weapons possible)</b>						
Firearm	100 (81)	11 (79)	10 (91)	74 (87)	195	0.62
Sharp instrument	11 (9)	1 (7)	1 (9)	8 (9)	21	1.00
Blunt force	9 (7)	1 (7)	0	4 (5)	14	0.83
Bodily force	3 (2)	1 (7)	0	2 (2)	6	0.54
<b>Time of week</b>						
Weekday (6:00 am Mon – 5:59 pm Fri)	86 (71)	6 (50)	7 (64)	55 (66)	154	0.45
Weekend (6:00 pm Fri – 5:59 am Mon)	35 (29)	6 (50)	4 (36)	28 (34)	73	

Time of event						
6:00 pm to 5:59 am	76 (70)	7 (58)	5 (45)	51 (62)	139	0.32
6:00 am to 5:59 pm	33 (30)	5 (42)	6 (55)	31 (38)	75	
Total events by category	124	14	11	85	234	

\* *SIC, Standard Industrial Classification (64).*

Table 4.6. Type of firearm by robbery motive and workplace violence typology for occupational homicide events in which firearms were used, North Carolina, 1994 – 2003.

Type of firearm*	Motive		Workplace Violence Typology				
	Robbery	Non-robbery	Type I	Type II	Type III	Type IV	Unknown
Handgun	65 (82)	51 (69)	54 (83)	12 (71)	13 (50)	22 (76)	15 (94)
Rifle	3 (4)	10 (14)	4 (6)	0	5 (19)	4 (14)	0
Shotgun	11 (14)	13 (18)	7 (11)	5 (29)	8 (31)	3 (10)	1 (6)
Total	79	74	65	17	26	29	16

\* Type of firearm was unspecified for 70 of the 223 events in which a firearm was used.

Figure 4.1. North Carolina occupational homicides by robbery motive and workplace violence typology occurring each day of the week, 1994 – 2003.

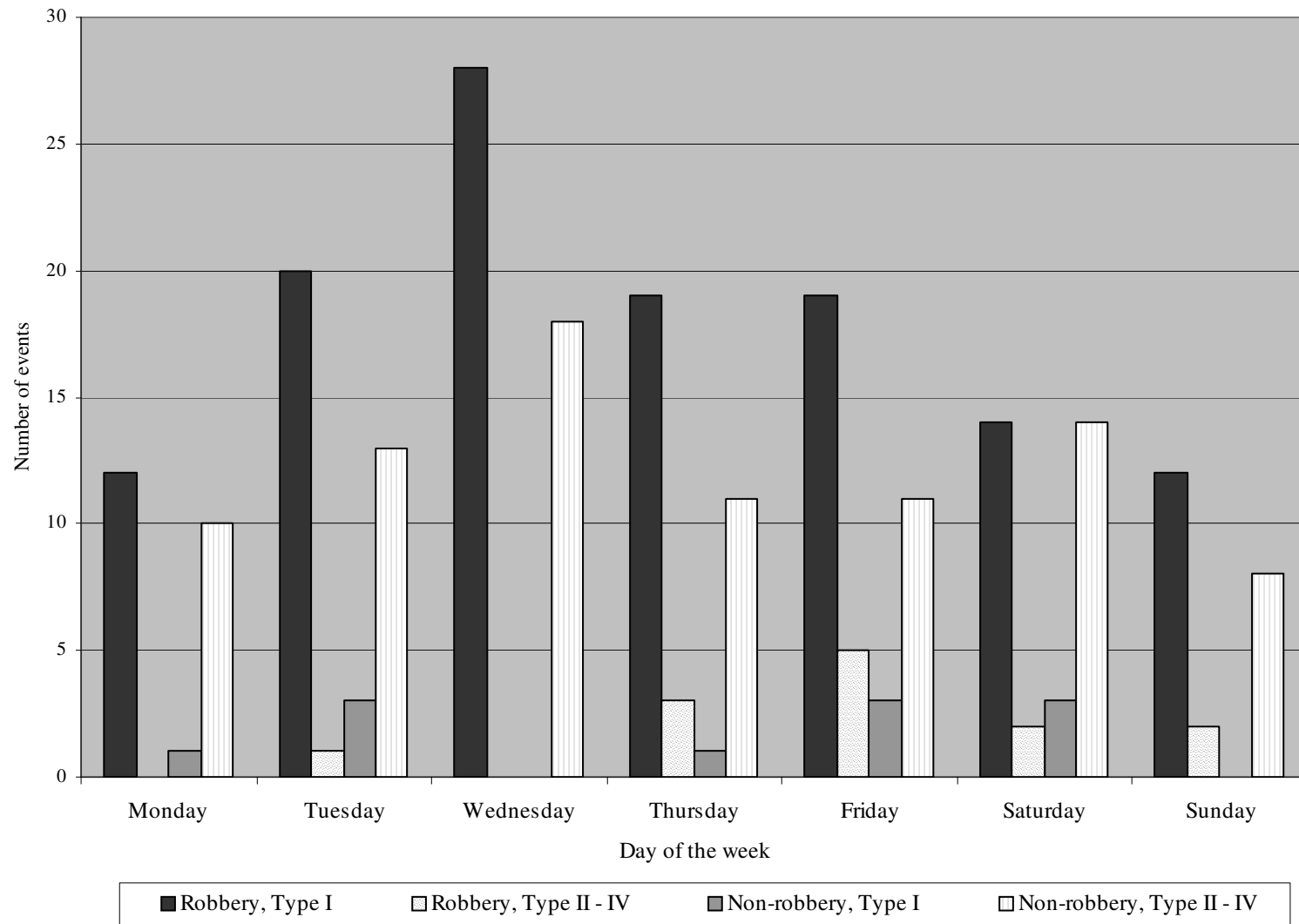
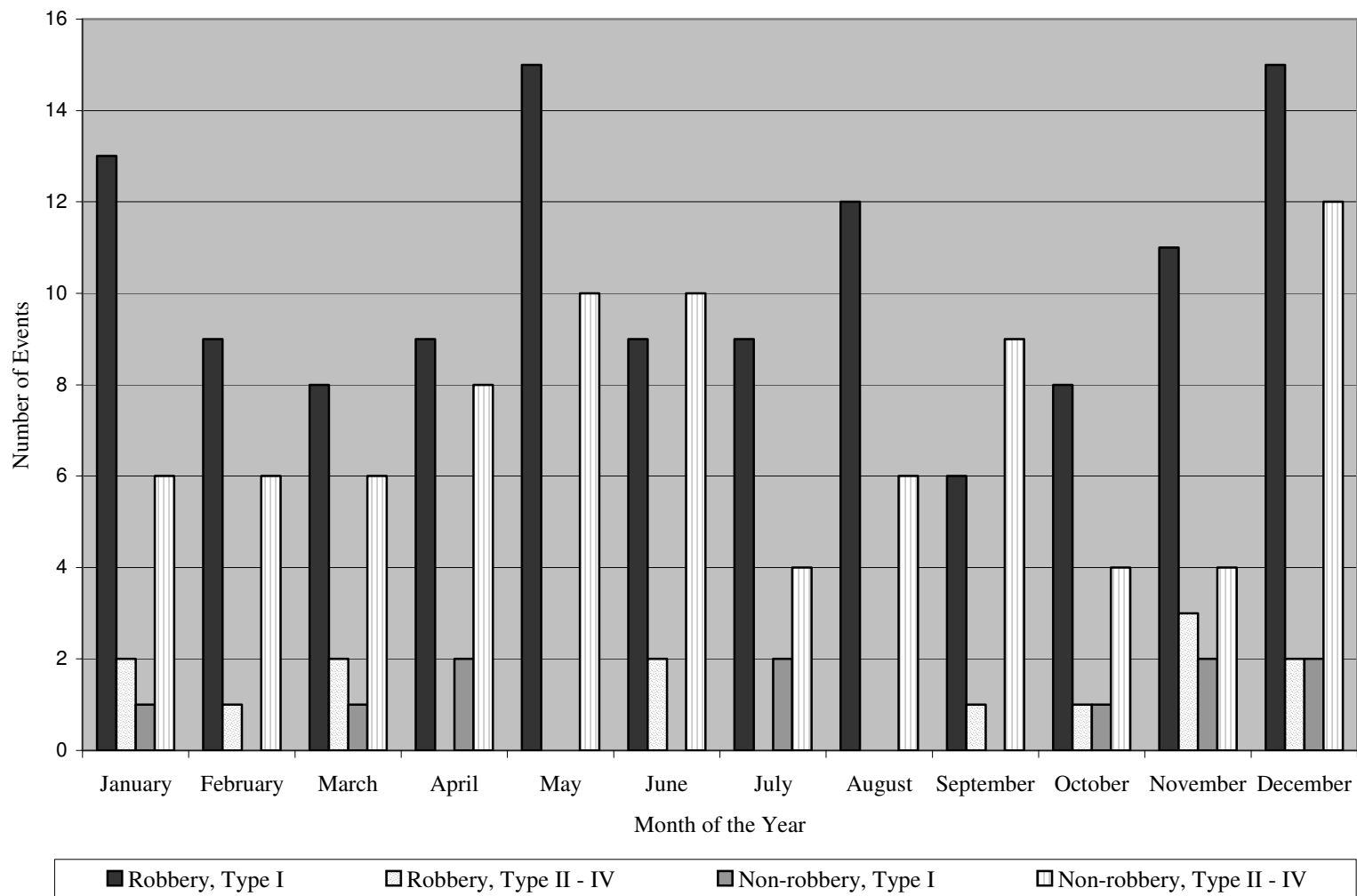


Figure 4.2. North Carolina occupational homicides by robbery motive and workplace violence typology occurring each month of the year, 1994 – 2003.



## CHAPTER 5

### AN EXAMINATION OF STRATEGIES FOR PREVENTING WORKPLACE HOMICIDES COMMITTED BY PERPETRATORS HAVING A PRIOR RELATIONSHIP WITH THE WORKPLACE OR ITS EMPLOYEES<sup>2</sup>

#### **5.1. Introduction**

Prevention of occupational violence has become an issue of pressing importance for occupational safety and health researchers (16, 77). Homicide is the second leading cause of fatal occupational injury among women (after transportation) and the fourth leading cause of such deaths among men (following transportation, falls, and being struck by an object, respectively) (6). Homicide accounts for nearly 500 male and almost 100 female deaths annually in the U.S. working population (6).

To assist in the identification of prevention strategies for reducing workplace violence, the California Department of Industrial Relations developed a way to categorize workplace violence based on the profiles of perpetrators (20). This typology divided violent workplace events into three, and later four, categories: Type I events are those in which the perpetrator has no legitimate relationship with the workplace or its workers, Type II events are those events in which the perpetrator was a client or customer receiving goods or services from the workplace, Type III events are those in which the perpetrator is a former or current employee of the workplace, and Type IV events are

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<sup>2</sup> This chapter will be submitted to a journal for publication. Authors will include at least Kelly K. Gurka, Stephen W. Marshall, Dana P. Loomis, and David B. Richardson.



those in which the perpetrator has a personal relationship, such as intimate partner or sibling, with an employee of the business (1, 2). Much of the effort in the research of workplace violence prevention has focused on robbery and robbery-related homicide (32, 33, 37, 39, 40, 42, 48). This study focused on homicides not related to robbery that were perpetrated by individuals with a prior relationship to the workplace or its employees, that is customers or clients of the workplace (Type II violence), former or current employees of the workplace (Type III violence), or personal friends, partners, or family members of employees (Type IV violence) (prior-relationship homicide) (2).

Prior-relationship homicides accounted for 12 to 23 percent of workplace homicides annually over the last decade and occur in all major industrial sectors (Section 4.3) (2, 18). In recent years, the overall rate of occupational homicide has declined (18). This is due, in large part, to a reduction in robbery-related homicides (18). However, homicides committed by perpetrators known to workplaces or their employees, most of which have a motivation other than robbery, have experienced a much slower diminution (18).

Most workplace homicides (46%) occur in the retail sector, and the majority of workplace homicides are robbery-related (82%) (18). Research has largely focused on identifying factors that increase the risk of robbery and programs to reduce this risk (34-40, 42, 48). Strategies recommended by the National Institute for Occupational Safety and Health (NIOSH) for workplace violence prevention can generally be divided into environmental modifications to be made to the workplace and administrative policies and procedures to be utilized by the employer (26). Environmental attributes of the workplace suggested for the prevention of workplace violence include putting a physical

barrier between the public and employees, improving the visibility into the workplace from the exterior, improving the exterior lighting around the workplace, and using security devices such as security cameras, alarms, and mirrors (26). Recommended administrative policies include limiting access to the workplace, training employees with regard to workplace violence, and utilizing staffing procedures including stationing security guards or receptionists at entrances and never allowing employees to work alone (26).

In a survey of workplace managers, the Bureau of Labor Statistics (BLS) found that employers incorporate many of these recommendations into their workplaces, for example 72% of the establishments polled reported at least one form of security (security staff, physical security including locked entrances, or electronic security such as surveillance cameras) (78). Although not included in the recommendations, these establishments also employ ways to identify potential or current employees with a history of violence perhaps signaling that prior-relationship homicide is of concern to employers (78).

Although two studies have looked at workplace homicide generally, no studies have systematically assessed whether these recommended workplace violence prevention strategies are associated with a reduction in prior-relationship homicide (32, 33). The purpose of this study was to examine whether recommended environmental attributes and administrative policies, thought to be protective of robbery-related violence, also reduce the odds of prior-relationship homicide in the workplace.

## 5.2. Methods

### 5.2.1. Overview

This study compared workplaces experiencing a prior-relationship homicide to a group of control workplaces. The study excluded homicides for which there was a robbery motive, since these events are a small proportion of Type II, Type III, and Type IV homicides and have etiologic similarities to homicides with no prior relationship (Sections 4.3 and 4.4). Cases were all workplaces experiencing prior-relationship homicide in North Carolina in the years 1994 through 2003. Controls represent a sample of all workplaces in North Carolina during a similar period (1994 to 1998). The exposures of interest were the use or non-use of strategies recommended for the prevention of workplace homicide, which might reasonably be expected to prevent prior-relationship homicides. The Institutional Review Board of the University of North Carolina at Chapel Hill approved this study.

### 5.2.2. Study population

This study utilized, in part, data collected for a previous study which assessed the role of prevention strategies in preventing **any** kind of workplace homicide, i.e. prior-relationship violence and robbery-motivated violence (31). For this research, I restricted the case group from the previous study to prior-relationship workplace homicides. For reasons of statistical power, I also extended the case series. The previous study used all workplace homicides occurring in North Carolina from 1994 to the first quarter of 1998; I extended this through December 31, 2003 for the present study.

The methods by which cases and controls were identified are detailed elsewhere (31). Briefly, cases were identified through a review of all homicides recorded by the North Carolina Office of the Chief Medical Examiner (NC OCME) occurring 1994 through 2003. A case qualified for inclusion when the event precipitating death occurred in North Carolina, the violent injury occurred at work, death resulted within 365 days of injury, and the precipitating event did not involve illegal transactions (e.g. prostitution or illicit drug dealing). Workplaces classified as agriculture were excluded because a sampling frame for control farms could not be identified. In addition, workplaces classified as national security or police protection were excluded, since homicides to law enforcement are considered etiologically distinct from other workplace homicides (64). Because the adoption of workplace strategies applicable to businesses with storefronts or other contained structured environments was the exposure of interest, events occurring off-site, such as in customer homes or in mobile workplaces such as taxicabs, were excluded.

We reviewed 7128 deaths with manner classified as homicide by the NC OCME for the years 1994 to 2003. Of the 269 workplace homicides not classified as the military or law enforcement, 69 involved prior-relationship homicides. The flow chart in Figure 5.1 shows exclusions from the study.

During the original study, ten potential control workplaces were randomly selected from a sampling frame representing all workplaces in North Carolina (obtained from the *American Business List*), matched to each case occurring January 1, 1994 through March 31, 1998 by month of the fatal event (i.e. the control workplace had to be in operation during the month of the homicide occurring in the case workplace) and by

the first digit of the *Standard Industrial Classification* code (B – mining, C – construction, D – manufacturing, E – transportation and utilities, F – wholesale, G – retail, H – real estate, insurance, and finance, I - services, and J – public administration) (64, 79). The first two selected control workplaces that completed a questionnaire were included.

### 5.2.3. Data Collection

Data were obtained using a telephone interview with the manager for each workplace. If no one with knowledge of the workplace at the time of the event was available or willing to participate, we contacted law enforcement officers familiar with the workplace through their investigation of the homicide and asked them to participate as proxy informants for the workplace manager interview. Because of the tragic nature of these events, we did not contact any managers within six months of the incident. All of the interviews were completed within six years of the event.

Questionnaires were administered for 55 (80%) of the 69 eligible workplaces: the manager or a similar alternate completed 29 questionnaires, and proxy informants completed 26 questionnaires. Of the 14 cases with incomplete questionnaires, three were no longer in business, contact could not be established for two, and the remaining (n = 8) refused participation. Law enforcement agents were unable to complete these questionnaires as proxy informants. Workplaces for which managers or proxy informants participated did not differ from workplaces with incomplete questionnaires with regard to either workplace violence typology or industry sector (Table 5.1).

Workplace managers familiar with the control workplace at the time of the matched case were administered the same questionnaire. Two controls of the ten

potential controls for each of the 105 original case workplaces completed the questionnaire. This study utilized data from all 210 original controls.

#### *5.2.4. Main Exposures*

I divided the NIOSH prevention strategies into two broad categories: environmental attributes and administrative policies. Attributes of the physical environment included the presence of barriers physically separating employees from the public (e.g., counters, bullet-resistant barriers) (“yes” or “no”), whether employees in the workplace were visible from the exterior of the business (“yes” or “no”), and exterior lighting (“bright” or “somewhat bright” versus “dim” or “not at all bright”). I also examined the following of security devices: the presence of security cameras (“yes” or “no”), alarms that alert police or security guards (“yes” or “no”), and mirrors for security purposes or observing customers (“yes” or “no”).

Administrative policies of the workplace included measures to limit access to the workplace: whether the manager reported locked entrances during work shifts or being closed after hours if the workplace was open to the public (“yes” to one or both versus “no”) and whether the employer utilized swipe cards, identification badges, sign-in procedures, or signs prohibiting non-employees in certain work areas (“yes” to one or more versus “no”). I also explored the effect of employee training covering the following topics: how to avoid attack in a parking lot (“yes” or “no”), response to hostile co-workers (“yes” or “no”), response to hostile customers (“yes” or “no”), handling threats from intimate partners (“yes” or “no”), and handling threats from strangers (“yes” or “no”). Finally, I considered staffing practices: a security guard was stationed at the

entrance (“yes” or “no”), a receptionist worked at the entrance (“yes” or “no”), and staff ever worked alone (“yes” or “no”).

Because cash-handling policies do not have a plausible effect on non-robbery-related prior-relationship homicide and personal protective equipment is recommended for an excluded group of employees (i.e., military and law enforcement), I did not examine the effects of such policies on the odds of homicide. In addition, since the questionnaire from the original study did not query managers on the adoption of policies and procedures for assessing and reporting threats; I did not examine this recommendation.

#### *5.2.5. Covariates*

Participants were queried about violence occurring in the 48 months preceding the month of the homicide event including physical and sexual assault, shootings and stabbings, and physical threats made by employees, intimate partners, customers, or someone else. Workplaces with informants reporting any one of these items were classified as having a history of violence (“yes” to any one or more or “no” to all).

Based on findings from previous studies, potential confounders included the location of the business, the size of the business with regard to the number of employees, time at the current location, and hours during which employees were present in the workplace (26, 31-33, 48-53, 80). Each of the following types of locations was examined (and coded yes or no): business or commercial district, industrial park, residential area, and rural area. Small businesses were defined as those reporting ten or fewer employees versus more than ten employees. Workplaces were dichotomized on whether they had

been in the current location for two years or less (new location coded yes) or for greater than two years (new location coded no). For hours of operation (coded yes or no), the study examined any evening hours (6:00 pm to 8:59 pm), any night hours (9:00 pm to 5:59 am), any weekend hours (6:00 pm Friday to 5:59 am Monday), and ever open twenty-four hours per day. The study also examined the racial and ethnic composition of the workforce: any African-American employees (yes or no), any Asian employee (yes or no), and any employees of Hispanic ethnicity (yes or no).

#### 5.2.6. Data Analysis

Descriptive statistics were computed for each prevention strategy, a reported history of violence, and for characteristics that could potentially confound the prevention strategy–prior-relationship homicide association. Logistic regression models were fit for each prevention strategy to estimate the effect of each strategy on the odds of a prior-relationship homicide, adjusted for potential confounders. The analysis utilized exact logistic regression methods because of the modest sample size (68). The study assessed for confounding by six covariates: night hours of operation, being open to the public, small business size, new location, location within an industrial park, and any minority employee. I utilized forward selection to estimate the effect of each potential confounder on the odds ratio estimating the prevention-strategy – prior-relationship homicide association. Based on an *a priori* percent change criterion of 10% or greater, five of the six covariates (excluding open to the public) often confounded the main effects I evaluated, (see Appendices G through M for full details) (67). In the interest of comparability of estimates, I controlled the same set of five covariates in all models.



### **5.3. Results**

#### *5.3.1. Characteristics of case workplaces*

Perpetrators whose prior-relationship to the workplace was through a personal connection with a worker (Type IV) accounted for 42% of the prior-relationship homicides (Table 5.1). Customers or clients (Type II) and current or former employees (Type III) accounted for less than a third each of the prior-relationship homicides (Table 5.1). Most prior-relationship homicides occurred in the retail (31%), service (27%), and manufacturing (24%) sectors. Nearly all industry sectors experienced at least one prior-relationship homicide over the study period (Table 5.1).

#### *5.3.2. Risk factors for prior-relationship homicide*

Case workplaces were nearly five times (odds ratio (OR) = 4.93; 95% confidence interval (CI): 1.73, 15.55) as likely to report having experienced violence in the two years preceding the homicide event when compared to controls (Table 5.2; modifying effect on each of the main effects shown in Appendices G through M). Workplaces that employed any Asian workers or any Hispanic workers were more likely to have experienced a homicide when compared to workplaces without any Asian workers and without any Hispanic workers, respectively. In addition, location within an industrial park increased the odds of prior-relationship homicide (by a factor of nearly five) as did having employees present in the workplace at night (between the hours of 9:00 pm and 5:59 am) and ever being open 24 hours per day.

### *5.3.3. Prevention strategies: Environmental attributes*

Because the recommendation to place physical barriers between employees and the public were industry specific, the presence of a barrier was examined for only retail workplaces (14 cases and 121 controls) (26). Some type of barrier, including counters, desks, drive-through windows, and bulletproof rooms, was present in almost all retail case (93%) and control (92%) workplaces. The small number of cases and lack of exposure variability limited our ability to examine and interpret the association between physical barriers and prior-relationship homicide (Table 5.3; additional results shown in Appendices G through J). Visibility of employees from the exterior of the workplace was associated with a reduction in the odds of prior-relationship homicide; however, the effect was modest relative to the imprecision of the estimate (Table 5.3), so it is unclear from this study whether employee visibility affords protection. Exterior lighting likewise showed no discernable effect, considering the imprecision of the odds ratio.

Presence of at least one security device was associated with a reduction in the odds of prior-relationship homicide (OR = 0.28; 95% CI: 0.10, 0.73). I also examined the effect of each of these devices individually. Although this analysis was also limited by the imprecision of the estimates, the point estimates suggest that alarms alerting police or security guards may be protective for prior-relationship homicide (OR = 0.24, 95% CI: 0.05, 0.81).

### *5.3.4. Prevention strategies: Administrative policies*

Among the administrative policies, locked entrances may afford protection against prior-relationship homicides: case workplaces reported locking entrances when

employees were present or keeping entrances closed after hours if open to the public over 60% less often than control workplaces (Table 5.4; additional results shown in Appendices K through M). Limiting access (defined as one or more of the following: use of swipe cards to gain access to the work site, sign-in procedures for visitors, requiring employees to wear ID badges, and/or posting signs allowing only employees in designated areas) and employee training programs did not afford protection against prior-relationship homicides in this study.

Staffing practices were not associated with any reduction in the odds of a prior-relationship homicide. Imprecision limited the analysis of the effects of individual staffing practices. However, based on the point estimate, it appears that working alone might protect against prior-relationship homicide.

#### **5.4. Discussion**

This study suggests that strategies recommended by the National Institute for Occupational Safety and Health for the prevention of workplace violence may not have an adequate impact on the occurrence of prior-relationship homicide suggesting a need for interventions targeted specifically at this type of violence. Of the recommendations examined, I identified two specific workplace violence prevention strategies that may afford protection against prior-relationship homicides: use of at least one security device (alarms, mirrors, or security cameras) and limiting access to the workplace by locking entrances when employees are present or keeping the entrances closed outside of regular business hours if open to the public. Based on the retrospective nature of these data, it is challenging to interpret these associations. Workplaces that typically employ these

environmental protections and administrative policies may be at lower risk of prior-relationship homicide, or they may employ people with fewer violent relationships. Regardless, these findings must be regarded as preliminary due to the imprecision in the estimates of the odds ratios.

Previous studies as well as the current study have shown that a history of violence in the workplace is strongly associated with subsequent violence occurring in the workplace (33, 54). These workplaces may consequently adopt prevention strategies. Controlling for such a covariate may mask or dampen potentially protective effects of the exposure of interest (69). Rather, history of violence should be assessed as a potential modifier of the association between prevention strategies and prior-relationship homicide. However, insufficient sample size precluded fitting models with an interaction term to explore the modifying effect of history of violent events with a multivariate analysis.

The evaluation of training programs and their effect on prior-relationship homicides warrants further investigation. The findings suggest that training has little effect on the odds of prior-relationship homicide. Caution should be taken in making this conclusion, however, as the data have several limitations. The data collected do not allow process evaluation, and the comparability of reported training programs across workplaces is unknown. The questions posed to workplace managers and proxy informants were dependant upon the respondent's definition of a training program, and these definitions likely ranged widely among participants. Because these data demonstrate that a prior history of violence is a risk factor for a prior-relationship homicide, an association between employee training and workplace homicide is difficult to interpret with retrospective data. It is not possible to ascertain whether the presence of

a training program was an institutional response to prior violence in the workplace. If so, any protective effect that training might afford may be dampened by the increased underlying risk of those workplaces adopting training programs. It seems unlikely, however, that implementing a training program would result in an increase in violence. Better-designed studies to address this question in particular should be undertaken.

Interpretation of the findings regarding staffing practices should be made with caution. Although the effect estimates suggest an association between staffing practices and prior-relationship homicide, the association may be a result of residual confounding. Robbery research has suggested that the presence of security guards is protective against the incidence of robbery, but once a robbery occurs, the risk of injury increases with the presence of guards because robberies during which a security officer is present tend to be more violent, in financial institutions for example, than robberies during which security officers are not present (45). It may be that workplaces that station guards at entrances or employ receptionists to greet visitors to the workplace have an underlying increased risk of prior-relationship homicide compared to workplaces that do not hire these employees. Small businesses are probably less likely to have these types of employees, and the study suggested that larger businesses are at greater risk of these types of homicides. Certainly, for employee-on-employee violence to occur among current employees, at least two employees must be present in the workplace. In addition, it may be that the more employees in a workplace, the greater the likelihood that one of those employees is a victim of violence.

Although robbery risk assessment studies have shown many of these strategies to be effective at preventing robbery-related violence, only two of the recommended

strategies appeared to afford protection during events precipitating homicides for which the perpetrator had a prior relationship with the workplace or its employees (34, 36-38, 42-44, 46). It is not surprising that the strategies would not have the same effect on prior-relationship homicide given the heterogeneity among robbery- and non-robbery-related workplace homicides (Sections 4.3 and 4.4).

#### *5.4.1. Limitations*

The major limitation of the study is the modest sample size. Despite efforts to improve the power of the study by extending the case series through 2003, the findings are largely inconclusive due to the imprecision in the effect estimates.

Although I controlled for a number of confounding factors when estimating the effect of each prevention strategy on the odds of prior-relationship homicides, constructs we did not measure, and other variables not assessed as potential confounders, could have biased the results.

Several sources of differential misclassification of exposure were possible. Because homicide is a particularly salient event, recall bias could have occurred in which cases systematically over- or under-reported the presence of the various prevention strategies compared to controls. Perhaps managers of case workplaces were more likely to recall what strategies were implemented at the time of the event, whereas, controls might have reported recent additions to their workplace violence prevention plan that were not, in fact, instituted at the time of the matched homicide. Social desirability may have affected respondents differently as well. Managers of case workplaces may desire to provide reassuring responses that do not imply responsibility. Managers of both case

and control workplaces may have been more likely to report the use of certain prevention strategies compared to proxy informants, which were only utilized for case workplaces. Conversely, proxy informants may have been more prone to reporting errors due to their less intimate knowledge of the work site and administrative policies instituted in the workplace.

Because the series of controls to which the cases were compared was not extended to include 1999 through 2003, any temporal changes in the adoption of the prevention strategies under investigation in this research among North Carolina workplaces would not be represented. However, if the distribution of violence prevention strategies in the control workplaces accurately reflects the distribution of these strategies in the source population for the cases, then the effect of control selection is minimal, and previous research has shown that control workplaces are not likely to change either their environmental layout or administrative policies (40, 78). A recent survey of workplaces suggests that employers are not motivated to change their workplace violence prevention procedures (78). Despite a third of the establishments reporting a negative impact on their workforce resulting from a violent incident in the preceding 12 months, only 10% reported implementing any changes to their workplace violence prevention programs or policies (78). During a randomized intervention trial for a customized workplace violence prevention program for small businesses, researchers followed businesses randomized to no intervention to document any changes in their workplace violence programs. The controls largely made no improvements to their security programs (40). Although we do not have external data to determine whether the prevalence of prevention

strategies in North Carolina workplaces changed from 1998 to 2003, these previous studies suggest that limited changes are likely.

We also included all of the original controls in the analysis when we limited the cases to only those experiencing prior-relationship homicides, but the controls were matched by major industrial sector. The industrial mix of workplaces that experience robbery-related crimes differs from that of prior-relationship homicides (Section 4.3). If industrial sectors implement prevention strategies differently, the estimate of the distribution of each strategy under examination may not accurately reflect the distribution of that strategy in the source population for these cases. Thus, a selection bias may have occurred.

#### *5.4.2. Strengths*

This was the first study to systematically examine the effect of recommended prevention strategies on prior-relationship homicides, which were identified through classification using the workplace violence prevention typology.

Based on our case ascertainment procedures, it is highly unlikely that we either missed case workplaces or that control workplaces participating in the study experienced a prior-relationship homicide in the month of its matched case homicide. Moreover, it is more unlikely that workplaces identified as cases were erroneously classified as experiencing a workplace homicide when one did not occur. Thus, misclassification of the outcome was highly unlikely.



Exposure data were derived from interviews rather than relying on record-based information. Respondents familiar with the physical workplace and typically the administrative policies employed in the workplace provided these data.

#### *5.4.3. Conclusions*

Although prior-relationship homicides do not comprise the majority of workplace homicides, they do account for a sizable fraction of these deaths to workers. We found that two prevention strategies routinely recommended for prevention of workplace violence (use of at least one security device and locking entrances) might afford some protection against prior-relationship homicide. Due to limitations in the data we collected, in particular the limited sample size, questions remain regarding the effectiveness of employee training programs. Research designed specifically to address these questions should be conducted, including process evaluation to determine how well workplaces deliver training programs to their employees and outcome evaluation assessing the effectiveness of individual training components. In addition, since the release of the 1996 NIOSH recommendations examined in this study, updated suggestions have been published aimed specifically at Type II, Type III, and Type IV workplace violence; yet the effectiveness of these recommendations remains unknown (24). And, to prevent Type II and Type III violence, workplaces are employing strategies for which we do not know their effectiveness (78). Furthermore, heterogeneity exists among the component types of prior-relationship homicide (Section 4.3). A sufficiently powered study to examine the effect of prevention strategies within each type of workplace homicide would better answer some of these research questions. I intend these

findings to serve as a stimulus for further research in the area of non-robbery-related workplace violence prevention.

Table 5.1. Study participation by workplace violence typology and *Standard Industrial Classification* code for workplaces experiencing prior-relationship homicides, North Carolina, 1994 – 2003.

	Respondents		Refusals		Exact p-value
	n	%	n	%	
<b>Workplace violence typology*</b>					
Type II: Customer or client	17	31	3	21	0.70
Type III: Current or former employee	15	27	5	36	
Type IV: Personal relationship with an employee	23	42	6	43	
<b>Industry sector†</b>					
Mining	0	0	0	0	0.36
Construction	1	2	0	0	
Manufacturing	13	24	7	50	
Transportation and utilities	2	4	0	0	
Retail	17	31	6	43	
Real estate, insurance, finance	5	9	0	0	
Services	15	27	1	7	
Public administration	2	4	0	0	

\* Developed by the California Department of Industrial Relations, published by Howard, expanded by Peek-Asa, et al (1, 2, 20).

† Workplaces classified as the agricultural sector were excluded from the study.

Table 5.2. Association between prior-relationship workplace homicide and select business characteristics, North Carolina, 1994 – 2003.

	Cases		Controls		Unadjusted		Adjusted*	
	n = 55	%	n = 210	%	OR <sup>†</sup>	95% CI <sup>†</sup>	OR <sup>†</sup>	95% CI <sup>†</sup>
Reported history of violence (including threats) within previous 2 years	26 / 38	68	50 / 191	26	6.11	2.71, 14.23	4.93	1.73, 15.55
Small business ( $\leq 10$ employees)	21 / 23	48	137 / 209	66	0.48	0.24, 0.98	1.06	0.34, 3.24
Ethnicity and race of employees								
Any African-American	25 / 40	63	92 / 208	44	2.10	1.00, 4.54	1.11	0.36, 3.39
Any Asian	10 / 42	24	12 / 208	6	5.10	1.80, 14.01	4.86	1.35, 18.06
Any Hispanic	11 / 42	26	16 / 208	8	4.26	1.61, 10.78	3.43	0.96, 12.06
Location								
Business/commercial district	39 / 53	74	148 / 209	71	1.15	0.56, 2.46	1.46	0.55, 4.36
Industrial park	10 / 54	19	11 / 210	5	4.11	1.46, 11.34	4.85	0.99, 22.26
Residential area	30 / 54	56	97 / 210	46	1.46	0.76, 2.79	1.42	0.60, 3.39
Rural area	13 / 54	24	59 / 210	28	0.81	0.37, 1.68	1.12	0.41, 2.88
Hours of operation								
Any evenings (6:00 pm – 9:00 pm)	24 / 46	52	106 / 206	51	1.03	0.52, 2.06	1.31	0.55, 3.21
Any nights (9:00 pm – 5:59 am)	29 / 46	63	64 / 206	31	3.78	1.85, 7.87	5.03	1.92, 14.18
Any weekends	36 / 47	77	150 / 210	71	1.31	0.60, 3.04	1.77	0.65, 5.53
Ever open 24 hours	14 / 48	29	23 / 210	11	3.35	1.43, 7.55	3.55	1.22, 10.21

\* Adjusted for other confounding variables in table (small business, any minority employee, location in a business park, and/or any night hours or operation) and at current location 2 or fewer years.

\* OR, odds ratio; CI, confidence interval. Estimated using exact logistic regression.

Table 5.3. Association between prior-relationship workplace homicide and select attributes of the physical work site, North Carolina, 1994 – 2003.

	<u>Cases</u>		<u>Controls</u>		<u>Unadjusted</u>		<u>Adjusted*</u>	
	n = 55	%	n = 210	%	OR <sup>†</sup>	95% CI <sup>†</sup>	OR <sup>†</sup>	95% CI <sup>†</sup>
Physical barriers <sup>‡</sup>	13 / 14	93	95 / 103	92	0.97	0.11 46.94	--	--
Employee visibility	24 / 54	44	126 / 210	60	0.55	0.29 1.06	0.67	0.26, 1.73
Exterior lighting	43 / 52	83	165 / 209	79	1.27	0.56 3.20	1.39	0.42, 6.01
Security devices								
Security cameras	9 / 50	18	33 / 208	16	1.16	0.45, 2.74	0.93	0.29, 2.69
Alarms	5 / 51	10	54 / 205	26	0.30	0.09, 0.82	0.24	0.05, 0.81
Mirrors	9 / 52	17	44 / 210	21	0.79	0.31, 1.81	0.43	0.10, 1.43
Any of above	16 / 50	32	97 / 206	47	0.53	0.26, 1.06	0.28	0.10, 0.73

\* Adjusted for night hours of operation, small business size, at current location two years or fewer, located in an industrial park, and having any minority employees.

† OR, odds ratio; CI, confidence interval. Estimated using exact logistic regression.

‡ Only retail workplaces (n = 135) were included in the physical barriers analysis.

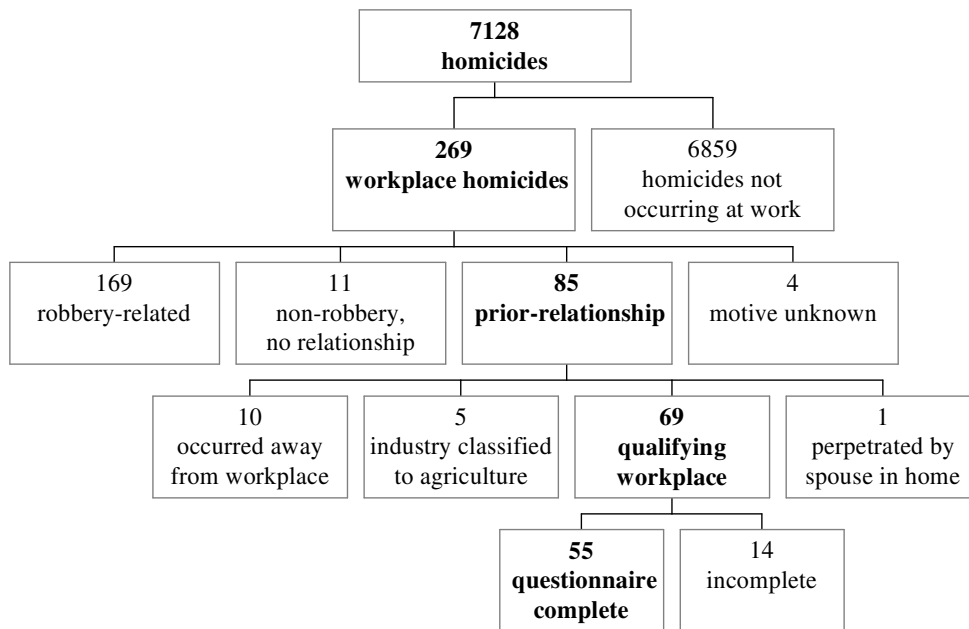
Table 5.4. Association between prior-relationship workplace homicide and select administrative policies, North Carolina, 1994 – 2003.

	<u>Cases</u>		<u>Controls</u>		<u>Unadjusted</u>		<u>Adjusted*</u>	
	n = 55	%	n = 210	%	OR	95% CI	OR	95% CI
<b>Access policies</b>								
Locked entrances	34 / 49	69	178 / 210	85	0.41	0.19, 0.90	0.34	0.13, 0.92
Limit access	32 / 48	67	105 / 209	50	1.98	0.98, 4.10	1.35	0.51, 3.68
Either of above policies	42 / 49	86	191 / 210	91	0.60	0.22, 1.79	0.29	0.09, 1.08
<b>Employee training</b>								
Attack in parking lot	7 / 34	21	64 / 210	31	0.59	0.21, 1.49	0.62	0.20, 1.71
Hostile co-workers	15 / 36	41	58 / 208	28	1.93	0.86, 4.29	1.52	0.57, 4.00
Hostile customers	15 / 37	41	105 / 209	50	0.71	0.32, 1.53	0.77	0.29, 2.01
Threats from intimates	13 / 38	34	41 / 210	20	2.14	0.92, 4.79	1.58	0.54, 4.42
Threats from strangers	13 / 37	35	62 / 210	30	1.35	0.56, 2.98	0.83	0.28, 2.25
One or more of above	24 / 36	67	128 / 210	61	1.28	0.58, 2.97	0.90	0.33, 2.60
<b>Staffing practices</b>								
Employees never work alone	25 / 47	53	73 / 209	35	2.12	1.06, 4.23	2.02	0.74, 5.64
Security guard at front	9 / 54	17	11 / 210	5	3.68	1.26, 10.44	2.21	0.58, 7.76
Receptionist at front	26 / 55	47	68 / 210	32	1.93	1.01, 3.72	2.00	0.70, 5.79
Any of above practices	39 / 50	78	116 / 210	55	2.87	1.35, 6.55	2.60	0.78, 9.44

\* Adjusted for night hours of operation, small business size, at current location two years or fewer, located in an industrial park, and having any minority employees.

† OR, odds ratio; CI, confidence interval. Estimated using exact logistic regression.

Figure 5.1. Prior-relationship homicide case ascertainment flow chart including exclusions, North Carolina, 1994 – 2003.



## CHAPTER 6

### CONCLUSION

#### **6.1. Summary**

Although intentional violence is an important cause of occupational fatality, little research has been conducted examining the epidemiology of workplace homicide. Most of that research has focused on robbery-related violence. Despite the fact that recommendations for preventing workplace violence exist and many are widely implemented, before this study, no studies had systematically assessed whether these strategies reduce the risk of prior-relationship homicide.

This dissertation reports two studies. In the first study, I assembled a case series of occupational homicides in North Carolina occurring in the years 1994 through 2003. I contrasted robbery-related and non-robbery-related events and classified each homicide using a previously published occupational violence typology (1, 2, 20).

The results demonstrate limitations of the typology. The current system does not include mutually exclusive categories, and a high level of diversity can exist within each category. Both pose a challenge for developing comprehensive interventions.

Approaches aimed at homicide as a whole may be effective for only a portion of those fatalities, making program development and evaluation more difficult. Robberies have been the most studied event during which occupational homicides occur, and the kind for which most intervention strategies have been assessed (32-40). I have demonstrated that



homicides in which the perpetrator entered the workplace only for criminal intent do not always involve robbery, and that robbery can motivate homicides for which the perpetrator has a relationship with the workplace or its employees.

In general, the assumptions inherent to the current classification system hold true. Most North Carolina occupational homicides occurred during robbery of the workplace (63%), and strangers perpetrated over two-thirds (73%) of the robbery-related killings. However, a sizable fraction (37%) of occupational homicides during the study period were not robbery-related. Perpetrators with a prior relationship with the workplace or an employee committed 89% of non-robbery-related homicides. Homicides not related to robbery occurred in a range of industrial sectors (retail: 28%, service: 26%, and manufacturing: 22%), whereas robbery-related homicides occurred overwhelmingly in the retail sector (67%). The results also demonstrate that non-robbery-related homicides comprise a meaningful fraction of occupational homicides, and non-robbery- and robbery-related homicides are distributed differently across violence typology and industry.

The second study, a case-control study examined whether recommended environmental designs and administrative policies, thought to be protective of robbery-related violence, protect against prior-relationship homicide. The case-control study suggested that workplaces reporting a history of violence, employing any minorities of Asian race or Hispanic ethnicity, located in an industrial park, operating during any night hours, or operating 24 hours any day were more likely to experience prior-relationship homicide. Keeping entrances to the workplace locked when employees were present or keeping entrances closed after regular business hours if open to the public (OR = 0.36, 95% CI: 0.13, 0.99) and having at least one security device (OR = 0.28, 95% CI: 0.10, 0.74) appeared to

protect against prior-relationship homicide. This study was inconclusive as to whether employee training was an effective strategy for reducing the risk of prior-relationship homicide.

The study was the first of its kind to examine the relationship between recommended prevention strategies for robbery and prior-relationship homicides; however, there were limitations to the study. Sample size was limited and all exposure data were based on retrospective recall of either workplace managers, or, in 47% of interviews, law enforcement officers. Homicides are typically tragic, emotional events that could affect the recall of managers differentially between case and control workplaces. Although we sought to collect information about the workplace soon after the event, managers may have reported more recent improvements to the workplace violence prevention plan that were not in place at the time of the homicide. In addition, control selection was not ongoing through the end of the study period, and temporal changes in the adoption of prevention strategies by control workplaces could have also biased the results. Controls were also selected based on the industry sector of those occupational homicides occurring 1994 – 1998. Thus, the controls participating in the study may not best represent the population from which these cases arose. If the distribution of the prevention strategies differed between the source population of workplaces and the controls included in the study, the findings may not portray the true effect of the prevention strategies on the risk of prior-relationship workplace homicides.

## **6.2. Directions for Future Research**

Although this study suggests some strategies used to prevent workplace robberies may also afford protection against prior-relationship homicide, the findings are not

conclusive, and heterogeneity exists within the different types of prior-relationship homicide. A sufficiently powered study to examine the effect of prevention strategies within each type of workplace homicide would better answer some of these research questions. In order to conduct such a study, either a longer study period or a larger geo-political region needs to be evaluated to afford the needed sample size of cases. A prospective design would eliminate the temporal ambiguity present in this study, and site visits to workplaces to assess the environment and administrative policies used by employers would improve data collection efforts over the current study. However, workplace homicide is a relatively rare event. Consequently, a prospective study would require extensive resources.

Due to limitations in the data we collected, questions remain regarding the effectiveness of employee training programs. Research designed specifically to address these questions should be conducted, including process evaluation to determine how well workplaces deliver training programs to their employees and outcome evaluation assessing the effectiveness of individual training components. The quality of the training program as well as its comprehensiveness also needs to be considered. A randomized workplace trial would be an effective, though intensive, approach to accomplishing these two goals. Close attention should be paid to the existing literature in developing the training materials. With the careful design of the study including both process and outcome evaluation, conclusions could be made about how best to implement employee training in the workplace as well as which individual components of a training curriculum were most effective.

In addition, since the release of the 1996 NIOSH recommendations examined in this study, updated suggestions have been published aimed specifically at Type II, Type III, and Type IV workplace violence; however, the effectiveness of these recommendations remains

unknown (24). Strategies aimed specifically at preventing violence perpetrated by customers or clients include adequate staffing, training, and accreditation criteria tied to workplace violence prevention program and training requirements (24). Strategies aimed specifically at preventing violence perpetrated by employees include evaluating prospective workers, employee training regarding workplace violence policies including reporting prohibited behaviors, and focusing on observable behaviors of employees (24). Strategies aimed at preventing violence perpetrated by personal relations such as intimate partners of employees include employee training in policies and disclosure of violence and encouraging a culture of support for victims (24). In an effort to prevent prior-relationship violence, workplaces are already employing some of these strategies such as processes or methods to identify potential or current employees with a history of violence; yet we do not know their effectiveness (78). These recent additions to recommended workplace violence strategies should also undergo formal evaluation, ideally in a manner similar to that described above. Various combinations of the various prevention strategies should also be considered, for strategies used in combination with one another may afford greater protection than any single strategy alone.

We included in neither the case series nor the assessment of prevention strategies, homicides occurring in the police protection or national security sectors. Because these industries are at increased risk of workplace homicide, research examining these homicides could be conducted (71). Additional recommendations specifically tailored to these groups of workers, like the current recommendation to use personal protective equipment, may also be effective at preventing the escalation of violence to a homicide (26). Although workers in these jobs encounter violence as part of their duties, it is likely that prior-relationship homicides occur in these workplaces as well. This could be explored.

Finally, a number of events, especially related to intimate partner violence, occurred in the parking lots of workplaces. The recommendations under study largely target the interior work area of employees rather than areas exterior to the work building. The extent to which non-robbery-related events occur exterior to the work building should be explored as well as strategies aimed at these types of events specifically developed and evaluated.

### **6.3. Public Health Implications**

Despite recommendations being disseminated by the occupational safety and health research arm of the government, the majority of workplaces examined in this study had not adopted many recommended strategies to prevent workplace homicides, signaling, perhaps, a perception that workplace homicide is not a problem in America's workplaces. However, according to the Bureau of Labor Statistics' *Survey of Workplace Violence Prevention, 2005*, workplace violence occurred in five percent of the more than 7.3 million establishments, including State and local governments in just the last 12 months, and half of large workplaces (those with 1,000 or more workers) experienced a violent event in the preceding twelve months. Conceivably, workplace management may also be unaware that such recommendations exist, or may lack the resources necessary to implement the recommendations. Efforts to educate workplace management and employees on the incidence and prevention of occupational violence should nonetheless continue.

Although research efforts to address robbery-related workplace violence have been ongoing, more work needs to be done. Despite robberies accounting for the majority of the workplace homicides, a disparate amount of research has focused on robbery-related events. Resources need to be allocated for the continued study of the circumstances that lead to both

robbery- and non-robbery-related workplace violence as well as effective ways in which to prevent these events and disseminate information to workplaces in greatest need of assistance.

Based on these findings, researchers can build on the research to address persistent gaps in our knowledge. Employers should keep the entrances to their workplaces locked when possible to prevent both robbery- and non-robbery-related violence. For employers that must allow workplace access to function, they can likewise minimize risks to their employees by keeping the workplace closed outside of regular business hours. For workplaces in which keeping entrances locked is feasible, it is a low-cost intervention that is easily implemented. Based on the cost involved to the employer and inconsistent findings in the literature, however, the recommendation to use security devices is questionable.

#### **6.4. Conclusions**

This research demonstrates that non-robbery-related homicides comprise a meaningful fraction of workplace homicides, differ from robbery-related homicides, and may have different protective factors than robbery-related homicides.

Based on these findings, it may be useful to incorporate considerations of motive into the current workplace violence typology. Additional research is indicated to evaluate violence prevention strategies and identify those protective of prior-relationship homicides.

APPENDIX A  
Survey Instrument

Prior-relationship Homicide in the Workplace  
Case Interview Form

CC-ID#

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Interviewer (initials):

K	G
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Interview completed:  
C = complete  
P = partial

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List all parts completed:

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Date completed:

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Data entry completed:  
Y = yes

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Interview Start Time: \_\_\_\_\_ (24 hour time)

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I want to reassure you that all of your answers will be kept confidential and that your name and the name of your business will never be associated with any of the specific information you provide.

We would like you to answer all of the questions in the interview, but feel free to refuse to answer any particular question. Some of the questions may seem repetitive or do not apply to your business, but I must ask each question as written. Also, let me know if you do not understand any of the questions.

1. First, how many years has your business been at its current location?

\_\_\_\_\_ years

Only use appropriate prompts if the answer is at the margin points

- 1 = less than six months
- 2 = 6 - 11 months
- 3 = 1 - 2 years
- 4 = 3 - 5 years
- 5 = more than 5 years
- 7 = not completed
- 8 = refuse
- 9 = don't know

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To answer the rest of the interview, I want you to think back to \_\_\_\_\_ and use that time frame to answer the questions.

2. Back then was this a privately-owned company, a nonprofit organization, or a government agency?

1 = private, for profit	2 = non-profit or not-for-profit	government agency	7 = not completed	8 = refused	9 = don't know
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Two vertical lines for handwritten notes.

3 = federal 4 = state 5 = county 6 = local 0 = unspecified government agency
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3. Was your business part of a larger company?

0 = no	1 = yes	7 = not completed	8 = refused	9 = don't know
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3a. What company was that?

3b. What is the mailing address for that company (record, not coded)?

\_\_\_\_\_  
\_\_\_\_\_

4. What was the primary activity at your place of business?

Use Business Activity Probing Sheet to record any brief descriptions which apply. See table 1 for codes.

- 4a. \_\_\_\_\_
- 4b. \_\_\_\_\_
- 4c. \_\_\_\_\_
- 4d. \_\_\_\_\_
- 4e. \_\_\_\_\_

5. In \_\_\_\_\_ did any workers at your business routinely work away from the main location? This includes duties such as deliveries, sales, customer service, and working at construction sites.

0 = no	1 = yes	7 = not completed	8 = refused	9 = don't know
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<p>6. How many of your employees worked at construction sites? Would you say:</p> <p>1 = all, 2 = most, 3 = some, or 4 = none? 7 = not completed 8 = refused 9 = don't know</p> <p>7. How many of your employees used vehicles for their work (this includes taxi, car, bus, truck and repair or delivery vehicles)? Would you say:</p> <p>1 = all, 2 = most, 3 = some, or 4 = none? 7 = not completed 8 = refused 9 = don't know</p> <p>8. How many of your workers moved from site to site on foot when performing their main job (for example, like a town mailman)? Was it:</p> <p>1 = all, 2 = most, 3 = some, or 4 = none? 7 = not completed 8 = refused 9 = don't know</p> <p>9. How many of your workers routinely went to customers' homes or businesses, or met the customer at other locations? Was it:</p> <p>1 = all, 2 = most, 3 = some, or 4 = none? 7 = not completed 8 = refused 9 = don't know</p>	<input type="text"/>
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If all or most are given for any of questions 6 through 9, STOP and switch to the Mobile Workplace Questionnaire (blue).

Query for Fixed Workplaces

LOCATION

10. How many of your employees work at a fixed location?

1 = all	2 = most	3 = some	4 = none Go to Q65	7 = not completed	8 = refused	9 = don't know
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10a. Is that fixed location a private residence?

0 = no	1 = yes	7 = not completed	8 = refuse	9 = don't know
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10b. Is it your own or someone else's residence?

- 0 = someone else's residence
- 1 = own residence
- 7 = not completed
- 8 = refuse
- 9 = don't know

11. Response for questions 10, 10a, and 10b assumed by UNC staff.

- 0 = no
- 1 = yes

12. Was your place of business located within the city limits?

- 0 = no
- 1 = yes
- 7 = not completed
- 8 = refuse
- 9 = don't know

Please tell me if any of these other descriptions would have applied to the location of your business back in \_\_\_\_\_ (timeframe). You can answer "Yes" to more than one of these descriptions.

Was it located at...:	no	yes	not completed	refused	don't know
13a. ...an enclosed shopping mall?	0	1	7	8	9
13b. ...a non-enclosed strip shopping center?	0	1	7	8	9
13c. ...a business or commercial district?	0	1	7	8	9
13d. ...a residential area?	0	1	7	8	9
13e. ...an industrial park or area?	0	1	7	8	9
13f. ...a rural area?	0	1	7	8	9


13g. (If 13a -13f are all no): In your own words, how would you describe the location of your business back then?

14. Was your place of business located within 1/2 mile of an exit for an interstate highway?

0 = no	1 = yes	7 = not completed	8 = refused	9 = don't know
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15. Which interstate? \_\_\_\_\_

1 = I-40	2 = I-95	3 = I-85	4 = I-77	7 = not completed	8 = refused	9 = don't know
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16. What exit number or name was your business near?

Code # and/or name as follows: Exit 141, Manning Drive = 141-Manning DR.  
 777 = not completed  
 888 = refused  
 999 = don't know

Code Exit up to 15 characters \_\_\_\_\_

POPULATION DENSITY AND TRAFFIC

22. Back then how far was your business from the nearest other business or residence. Was it:

1 = attached	2 = less than 50 yards away	3 = more than 50 yards away	7 = not completed	8 = refused	9 = don't know
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<p>23. Was it possible for someone at that business or residence to see people entering your place of business?</p> <p>0 = no 1 = yes 7 = not completed 8 = refused 9 = don't know</p>
--

24. Were there usually people at that nearest business or residence while your workers were on duty?

- 0 = no
- 1 = yes
- 7 = not completed
- 8 = refused
- 9 = don't know

PARKING AND LIGHTING

25. Back then did you have a parking lot that was used by employees?

0 = no	1 = yes	7 = not completed	8 = refused	9 = don't know	<input type="checkbox"/>
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<p>26. Was the parking lot:</p> <p>1 = fenced and gated,                  2 = only fenced,                  3 = only gated across the driveway, or                  4 = neither one?                  7 = not completed                  8 = refused                  9 = don't know</p> <p>27. Was there a parking lot security guard?</p> <p>0 = no                  1 = yes                  7 = not completed                  8 = refused                  9 = don't know</p>	<input type="checkbox"/>	<input type="checkbox"/>
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28. How close did employees park to the entrance of the building? Did they park:

<p>1 = right next to it, meaning within 50 yards,                  2 = more than 50 yards from it, or                  3 = did employees not drive to work? (Skip to question 30)                  7 = not completed                  8 = refused                  9 = don't know</p>	<input type="checkbox"/>
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29. At that time, would you say the lighting throughout the entire parking area was:

<p>1 = very bright,                  2 = some dark spots,                  3 = dim throughout the area, or                  4 = there was no lighting in the parking area?                  7 = not completed                  8 = refused                  9 = don't know</p>	<input type="checkbox"/>
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30. Would you say the lighting on the outside of your building was:

- 1 = very bright,
- 2 = somewhat bright,
- 3 = dim, or
- 4 = that there is no lighting on the outside of the building?
- 7 = not completed
- 8 = refused
- 9 = don't know

31. During regular business hours, would you say that the interior lighting was:

- 1 = very bright,
- 2 = somewhat bright, or
- 3 = dim?
- 7 = not completed
- 8 = refused
- 9 = don't know

32. When employees were working before or after regular business hours, would you say that the interior lighting was:

- 1 = very bright,
- 2 = somewhat bright,
- 3 = dim, or
- 4 = that employees did not work outside of regular business hours?
- 7 = not completed
- 8 = refused
- 9 = don't know

33. Could someone working inside your business usually be seen from the outside?

- 0 = no
- 1 = yes
- 7 = not completed
- 8 = refused
- 9 = don't know

34. Still referring to the \_\_\_\_\_ time frame, did any workers ever work alone?

0 = no	1 = yes	7 = not completed	8 = refused	9 = don't know
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35. In general, between what hours was someone working alone? NOTE: Code up to two time intervals.

From \_\_\_\_\_ to \_\_\_\_\_

&

From \_\_\_\_\_ to \_\_\_\_\_

NOTE: Code using the 24 hour clock.

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36. Did any workers ever work in isolated areas? For instance, if a worker shouted, he or she would not have been heard.

- 0 = no
- 1 = yes
- 7 = not completed
- 8 = refused
- 9 = don't know



ENTRANCES AND ACCESS

For the next two questions I would like you to consider entrances which were open to the public. By open, I mean that a visitor could freely enter the workplace without locked barrier, receptionist, or guard to stop their entrance.

37. Back then, during regular business hours, were there any entrances open to the public?

- 0 = no
- 1 = yes
- 7 = not completed
- 8 = refused
- 9 = don't know

38. And when employees were working before or after regular business hours, were there any entrances open to the public?

- 0 = no
- 1 = yes
- 4 = employees did not work outside of regular business hours
- 7 = not completed
- 8 = refused
- 9 = don't know

During the hours when employees were routinely working, were there usually the following:	no	yes	not completed	refused	don't know
39. unlocked entrances,	0	1	7	8	9
40. security guards at any of the entrances,	0	1	7	8	9
41. receptionists at any of the entrances,	0	1	7	8	9
42. employees using magnetic swipe cards for gaining access during working hours,	0	1	7	8	9
43. ID badges worn by employees,	0	1	7	8	9
44. sign-in procedures for visitors,	0	1	7	8	9
45. and, finally, signs telling visitors not to enter certain areas?	0	1	7	8	9


SECURITY GUARDS

46. Was your business ever protected by security guards back in \_\_\_\_\_ (timeframe)?

0 = no	1 = yes	7 = not completed	8 = refused	9 = don't know	<input type="text"/>
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|

47. How many security guards were there? (See codebook for codes.)			77	88	99	<input type="text"/>
	no	yes	not completed	refused	don't know	
48. Was(were) the security guard(s) uniformed?	0	1	7	8	9	<input type="text"/>
49. Did the guard(s) work when other workers were present?	0	1	7	8	9	<input type="text"/>
50. Did the guard(s) work when no one else was working?	0	1	7	8	9	<input type="text"/>
51. Did the guard(s) circulate throughout the property?	0	1	7	8	9	<input type="text"/>
52. Did you advertise of post notices that security guards were on the premises?	0	1	7	8	9	<input type="text"/>
53. Did the guard(s) carry guns?	0	1	7	8	9	<input type="text"/>
54. Did the guards(s) carry any other type of weapons such as a Billy club or chemical sprays?	0	1	7	8	9	<input type="text"/>

55. Back then, if you had dialed 911, or telephoned for help, what law enforcement agency would have responded to the call?

1 = county sheriff	2 = local police	3 = other agency	4 = mobile workplace	7 = not completed	8 = refused	9 = don't know	<input type="text"/>
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| | |

56. Record the law enforcement agency. See codebook, table 1, to code.	<input type="text"/>
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57. Did your business have any arrangements with that agency to routinely patrol or drive by?

0 = no 1 = yes 7 = not completed 8 = refused 9 = don't know	<input type="text"/>
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VIDEO AND ALARMS

58. Did your business use video surveillance cameras?

0 = no	1 = yes	2 = yes, not in working order	7 = not completed	8 = refused	9 = don't know
--------	---------	-------------------------------	-------------------	-------------	----------------

59. Were any of the cameras clearly visible?

- 0 = no
- 1 = yes
- 7 = not completed
- 8 = refused
- 9 = don't know

60. Where were the cameras located? Were they:

- 1 = only inside the business,
- 2 = only outside the business, or
- 3 = both inside and outside?
- 7 = not completed
- 8 = refused
- 9 = don't know

61. Did your business have any kind of alarm system for a worker to alert police or security guards that someone was in danger?

0 = no	1 = yes	7 = not completed	8 = refused	9 = don't know
--------	---------	-------------------	-------------	----------------

62. Was it a silent alarm that did not ring in the building?

- 0 = no
- 1 = yes
- 7 = not completed
- 8 = refused
- 9 = don't know

63. Were there any mirrors used for security purposes or for observing customers?

- 0 = no
- 1 = yes
- 7 = not completed
- 8 = refused
- 9 = don't know

64. Were there any other kinds of security systems or procedures that your business used besides the ones I've mentioned?

0 = no	1 = yes	7 = not completed	8 = refused	9 = don't know
--------	---------	-------------------	-------------	----------------

Record up to two descriptions. See codebook, table 3, to code.

64a. \_\_\_\_\_

64b. \_\_\_\_\_

Query for All Workplaces

SAFETY TRAINING

Now I have some questions about safety training for your employees. Please continue to refer to the time period of \_\_\_\_\_.

Did your business offer safety training, or discuss safety with each employee, regarding:	no	yes	not complete d	refused	don't know	
65. ...what to do in a robbery situation?	0	1	7	8	9	
66. ...how to avoid being attacked in parking lots or while going to and from work?	0	1	7	8	9	
67. ...how to respond to hostile or threatening coworkers?	0	1	7	8	9	
68. ...how to respond to hostile or threatening customers and clients?	0	1	7	8	9	
69. ...self-defense?	0	1	7	8	9	

70. Did your business have any workplace strategies for helping your workers when threatened by spouses or partners?

- 0 = no
- 1 = yes
- 7 = not completed
- 8 = refused
- 9 = don't know

71. Did your business have any workplace strategies for helping your workers when threatened by strangers?

- 0 = no
- 1 = yes
- 7 = not completed
- 8 = refused
- 9 = don't know

GUNS AND WEAPONS

72. Back then did you allow employees to have guns with them while on duty?

- 0 = no
- 1 = yes
- 2 = no policy
- 3 = said "no," but voluntarily added that employer provided weapon
- 7 = not completed
- 8 = refused
- 9 = don't know

73. Were chemical sprays, such as mace or pepper spray, allowed for protection?

- 0 = no
- 1 = yes
- 2 = no policy
- 7 = not completed
- 8 = refused
- 9 = don't know

74. What about knives, to be used as weapons?

- 0 = no
- 1 = yes
- 2 = no policy
- 7 = not completed
- 8 = refused
- 9 = don't know

75. Were bats or clubs allowed?

- 0 = no
- 1 = yes
- 2 = no policy
- 7 = not completed
- 8 = refused
- 9 = don't know

76. Did you allow any other weapons?

- 0 = no
- 1 = yes
- 2 = no policy
- 7 = not completed
- 8 = refused
- 9 = don't know

ADMINISTRATIVE POLICIES

77. Did your business use pre-employment psychological tests to help screen out violent employees?

- 0 = no
- 1 = yes
- 7 = not completed
- 8 = refused
- 9 = don't know

Did your business check to see if job applicants had ever been convicted of a felony by:	no	yes	not completed	refused	don't know
78. ...asking about it on the application?	0	1	7	8	9
79. ...running a police record check to look for past felony convictions?	0	1	7	8	9


Now I want to ask you about how work was organized at your business during that same time period of \_\_\_\_\_.

80. How many shifts were there during a typical workday? \_\_\_\_\_

- 1 = one
- 2 = two
- 3 = three
- 4 = four or more
- 7 = not completed
- 8 = refused
- 9 = don't know

81. Was your business ever open to the public?

0 = no	1 = yes	7 = not completed	8 = refused	9 = don't know
--------	---------	-------------------	-------------	----------------

1

For each day of the week, what were the usual hours when your business was open to the public? (record next page)

For each day of the week, what were the usual operating hours at your business? (record next page)







The next few questions refer to the two years before \_\_\_\_\_ (time frame used through interview). Was the business in operation from \_\_\_\_\_ to \_\_\_\_\_?

Yes                   →                   Continue.  
 No                    →                   Skip to Question 120.

During those two years from _____ to _____ was an on-duty employee ever (excluding the reference homicide):	no	yes	did not exist	not completed	refused	don't know	
111. ...involved in a physical fight at work?	0	1	6	7	8	9	
112. ...sexually assaulted while at work?	0	1	6	7	8	9	
113. ...shot or stabbed at work?	0	1	6	7	8	9	
114. ...physically threatened by another employee at work?	0	1	6	7	8	9	
115. ...physically threatened by a spouse, boyfriend, or girlfriend at work?	0	1	6	7	8	9	
116. ...physically threatened by a customer at work?	0	1	6	7	8	9	
117. ...physically threatened by someone else at work?	0	1	6	7	8	9	

For the next two questions, I will ask you about robberies. By robbery I mean someone using force or the threat of force to take something of value. This does not include shoplifting or burglary when no one is present.

118. During those same two years prior to \_\_\_\_\_, was anyone ever robbed at your place of business?

0 = no	1 = yes	6 = did not exist	7 = not completed	8 = refused	9 = don't know	
--------	---------	-------------------	-------------------	-------------	----------------	--

<p>119. During those same two years, was there ever an attempted robbery at your place of business (excluding the reference)?</p> <p>0 = no          1 = yes          6 = not in business prior to timeframe          7 = not completed          8 = refused          9 = don't know</p>	
--	--

CASH TRANSACTIONS

For the remaining questions I would like you to once again consider the original time period we have been discussing, namely \_\_\_\_\_.

120. How often were transactions done in cash at your business? Would you say:

- 1 = all of the time,
- 2 = most of the time,
- 3 = some of the time,
- 4 = hardly ever, or —————> Skip to question 142.
- 5 = never? —————> Skip to question 142.
- 7 = not completed —————> Skip to question 142.
- 8 = refused —————> Skip to question 142.
- 9 = don't know —————> Skip to question 142.

121. Was there usually a counter or other barrier between the employees and customers when exchanging cash?

0 = no	1 = yes	7 = not completed	8 = refused	9 = don't know	
--------	---------	-------------------	-------------	----------------	--

I want to get an idea of all the possible types of barriers in your workplace used when exchanging cash. Was there...:	no	yes	not completed	refused	don't know	
122. ...a counter inside which was between the customer and the employee?	0	1	7	8	9	
123. ...a desk?	0	1	7	8	9	
124. ...a drive-through window?	0	1	7	8	9	
125. ...a booth or room with a bullet-proof window?	0	1	7	8	9	
126. ...a booth or room with a barred window?	0	1	7	8	9	
127. ...any other barrier?	0	1	7	8	9	

128. What kind of barrier? NOTE: See codebook for codes.	
---	--

To secure cash receipts, did your business use:	no	yes	not completed	refused	don't know
129. ...either a cash register or cash drawer?	0	1	7	8	9
130. ...a money drop-box which an employee could use when the cash register had too much money in it? (Employee can put money into safe but only the manager can remove it)	0	1	7	8	9




<p>131. Did the money drop-box have a time-delay system for making change?</p> <p>0 = no 1 = yes 7 = not completed 8 = refuse 9 = don't know</p> <p>132. Was the money drop-box visible to the public?</p> <p>0 = no 1 = yes 7 = not completed 8 = refuse 9 = don't know</p> <p>133. Was there a clearly visible sign indicating employees were unable to open the money drop-box?</p> <p>0 = no 1 = yes 7 = not completed 8 = refuse 9 = don't know</p>	<table border="1"> <tr><td></td></tr> <tr><td></td></tr> <tr><td></td></tr> </table>			

134) Did your business use a "safe" for storing cash receipts?

0 = no	1 = yes	7 = not completed	8 = refused	9 = don't know
--------	---------	-------------------	-------------	----------------

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<p>135. Was the safe visible to the public?</p> <p>0 = no 1 = yes 7 = not completed 8 = refused 9 = don't know</p> <p>136. Was there a clearly visible sign indicating employees were unable to open the safe?</p> <p>0 = no 1 = yes 7 = not completed 8 = refused 9 = don't know</p>	<table border="1"> <tr><td></td></tr> <tr><td></td></tr> </table>		


137. Besides taking money to the bank, did your business secure cash receipts in any other way?

0 = no	1 = yes	7 = not completed	8 = refused	9 = don't know
--------	---------	-------------------	-------------	----------------



See codebook to code description. 137a. 137b.
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138. Were there any clearly visible signs indicating a specific amount of cash on the premises?

0 = no	1 = yes	7 = not completed	8 = refused	9 = don't know
--------	---------	-------------------	-------------	----------------

139. What amount of cash was indicated by the sign? \$ _____
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140. How often was cash taken to the bank? Was it:

- 1 = more than once a day,
- 2 = daily, (not including weekends)
- 3 = weekly, or
- 4 = some other schedule? →
- 7 = not completed
- 8 = refuse
- 9 = don't know

Go to question 140a.

140a. What was that schedule? \_\_\_\_\_

141. How often did your business use the night deposit box at the bank? Was it:

- 1 = daily,
- 2 = weekends only, (Friday night, Saturday, Sunday)
- 3 = never, or
- 4 = some other schedule? →
- 7 = not completed
- 8 = refuse
- 9 = don't know

Go to question 141a.

141a. What was that schedule? \_\_\_\_\_

STAFFING

Finally I want to ask you about staffing. Please include yourself when counting the numbers of employees. If you are not certain of the exact number, please give the number that you think comes closest. Remember to focus on the same time period, \_\_\_\_\_.

- 142. What was the total number of male employees who worked at your business?
- 143. What was the total number of female employees?
- 144. Again counting you, how many employees were full-time workers; by this I mean they worked at least 35 hours per week?
- 145. Including part-time workers, how many of your employees were over age 65? Remember to include yourself.
- 146. Again including part-time workers, how many of your employees were under age 18?
- 147. Back then how many of your workers were white?
- 148. How many were black?
- 149. How many workers were Asian?
- 150. And how many were Hispanic?


151. Were there any other groups?

0 = no	1 = yes	7 = not completed	8 = refused	9 = don't know
--------	---------	-------------------	-------------	----------------

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<p>152. What group was that?</p> <p>NOTE: See codebook for code</p> <p>153. How many workers were in this group?</p>
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--	--	--	--

154. How many workers did not speak English as their first language?

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155. How many workers were usually on duty at the same time? \_\_\_\_\_

- 01 = 1 worker
- 02 = 2 workers
- 03 = 3 - 5 workers
- 04 = 6 - 10 workers
- 05 = 11 - 30 workers
- 06 = 31 - 100 workers
- 10 = 101 - 500 workers
- 11 = 501 - 1000 workers
- 12 = more than 1000 workers
- 77 = not completed

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CC\_ID: \_\_\_\_\_

88 = refuse  
 99 = don't know

156. In the 12 months prior to \_\_\_\_\_, what was your turnover rate, in other words what percent of the staff stopped working at your business? Be sure to include all full and part time workers.

\_\_\_\_\_

- 01 = less than 25%
- 02 = 25% - 49%
- 03 = 50% - 74%
- 04 = 75% - 99%
- 05 = 100% or more
- 06 = not in business prior to timeframe
- 07 = not applicable
- 77 = not completed
- 88 = refuse
- 99 = don't know

--	--

If the respondent suggests confusion, use the following formula:

\_\_\_\_\_ divided by \_\_\_\_\_ X 100 = \_\_\_\_\_ %  
 # who stopped working                      # who usually worked there

157. Were any of the workers at your business represented by labor unions?

0 = no	1 = yes	7 = not completed	8 = refused	9 = don't know
--------	---------	-------------------	-------------	----------------

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158. How many workers would you say belonged to a union? \_\_\_\_\_

159. Which union?  
 NOTE: See codebook to code.

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Thinking back to the day when the homicide occurred, was there anything unusual about the workplace, how things went at work, or how anybody was acting?

NOTE: See codebook, table 5 for codes.

200a		
200b		
200c		

The last 3 questions are about you as an employee. Remember that your answers will not be linked to your name or to your business in any way.

160. How long have you worked at this company? \_\_\_\_\_

- 1 = less than 6 months
- 2 = 6 - 12 months
- 3 = 1-3 years
- 4 = 4+ years
- 5 = not applicable
- 7 = not completed
- 8 = refused
- 9 = don't know

161. What is your current job title?

NOTE: See codebook, table 4 for codes.

162. And, how long have you had this job title?

- 1 = less than 6 months
- 2 = 6 - 12 months
- 3 = 1-3 years
- 4 = 4+ years
- 5 = not applicable
- 7 = not completed
- 8 = refuse
- 9 = don't know

Interview Stop Time: \_\_\_\_\_ (24 hour time)



163. These are all the questions I have. Is there anything you would like to say about preventing workplace violence?  
NOTE: See codebook, table 6 for codes.

200a		
200b		
200c		

Thank you very much for taking the time to answer these questions. We appreciate your help.  
We hope this study will help us learn more about how to prevent violence in the workplace.

---

To be answered by interviewer following survey administration:

164. Gender of Interview Subject

- 1 = male
- 2 = female
- 9 = don't know

165. What level of confidence did you have in the interview subject?

- 1 = low
- 2 = medium
- 3 = high

166. Was it difficult to understand the interview subject?

- 0 = no
- 1 = yes, describe below

167. Version Number

## APPENDIX B

### Initial Contact

Prior-relationship Homicide in the Workplace  
Case Interview: Initial Contact to Identify Manager

CC-ID#: \_\_\_\_\_

Workplace Name: \_\_\_\_\_

Workplace Phone Number: \_\_\_\_\_

“Hello, my name is Kelly Gurka from the University of North Carolina at Chapel Hill. I am conducting a study about workplaces throughout the state. I would like to send the manager of your workplace a letter explaining this study.”

“I would like to verify the name of the workplace. Have I reached  
\_\_\_\_\_?”

“Thank you. Could you please provide the current mailing address?”

\_\_\_\_\_  
\_\_\_\_\_, NC \_\_\_\_\_

“Thank you. May I now have the manager’s name?”

\_\_\_\_\_

NOTE: If no manager, “Who is in charge at the business?”

“Thank you. I will be sending [INSERT MANAGER NAME] a letter and will call back in about a week. Is this the best number at which to reach him/her?”

Yes

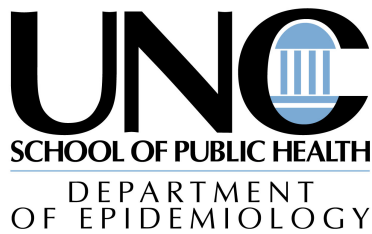
No: \_\_\_\_\_

“And, when is the best time to reach him/her?” \_\_\_\_\_

“Thank you so much for your time and assistance.”

## APPENDIX C

### Introductory Letter



[Date]

Dear [Workplace Manager Name],

I am writing to ask for your assistance in a study of dispute-related workplace homicide. The *North Carolina Study of Workplace Dispute Homicide* is being conducted for dissertation research at the University of North Carolina's Department of Epidemiology.

Approximately 40 homicides occur each year in North Carolina workplaces. Although UNC has conducted previous studies regarding workplace violence, this research aims to study specifically dispute-related workplace homicide.

I will be contacting managers of workplaces with a dispute-related homicide to ask them to participate in a survey. In the next few weeks, I will call asking you about characteristics of your workplace. I will ask questions pertaining to workplace attributes such as the physical layout, location, hours of operation, safety training, and security measures within your workplace. I intend to use this information to identify effective strategies for preventing violence in North Carolina workplaces. No compensation will be paid for participation in the study, and participation will only cost you your time.

The interview will take about 20 minutes. If the time at which I call is inconvenient for you, I will gladly reschedule a time at which we can talk. All of your responses will be kept confidential, and neither your name nor the workplace name will be reported. Your responses will be combined with those of over 200 other workplaces in North Carolina when the analysis is conducted. Though I would greatly appreciate full participation, the study is completely voluntary, and you may refuse to answer any question at any time during the interview.

Exposure to risks due to your participation is thought to be minimal. Your confidentiality will be protected and care will be taken to prevent deductive identification of your workplace. Your participation in the study has the potential to benefit both the working community of North Carolina and American workers elsewhere by providing information about the effectiveness of workplace violence prevention strategies.

If you have any questions regarding this study, please feel free to contact me at (434) 823-5745 or my advisor, Dr. Stephen Marshall at (919) 966-1320. The Public Health Institutional Review Board at the University of North Carolina at Chapel Hill has approved this study. If you have any questions about your rights, or are dissatisfied at any time with any aspect of this project, you may contact—anononymously—if you wish, the Public Health Institutional Review Board, School of Public Health, University of North Carolina at Chapel Hill, CB# 7400, Chapel Hill, NC 27599-7400, or by phone, collect if needed, 919-966-9347.

Thank you very much for your time, and I look forward to speaking with you.

Best regards,

Kelly K. Gurka, MPH  
Doctoral Candidate

APPENDIX D

Second Contact

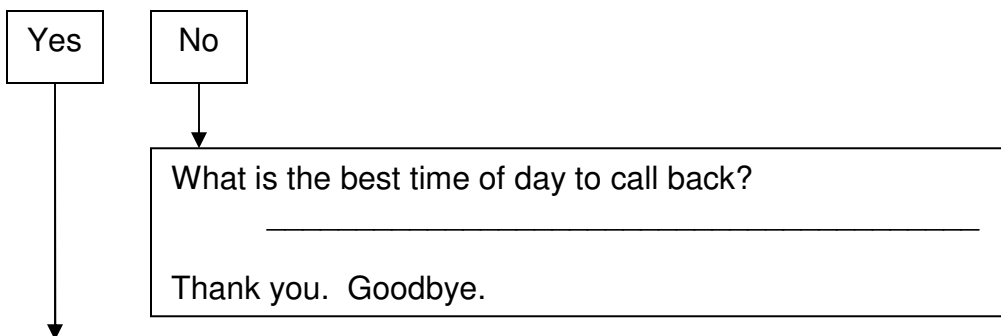
Prior-relationship Homicide in the Workplace  
Case Interview: Contact for Beginning Interview

CC-ID#: \_\_\_\_\_

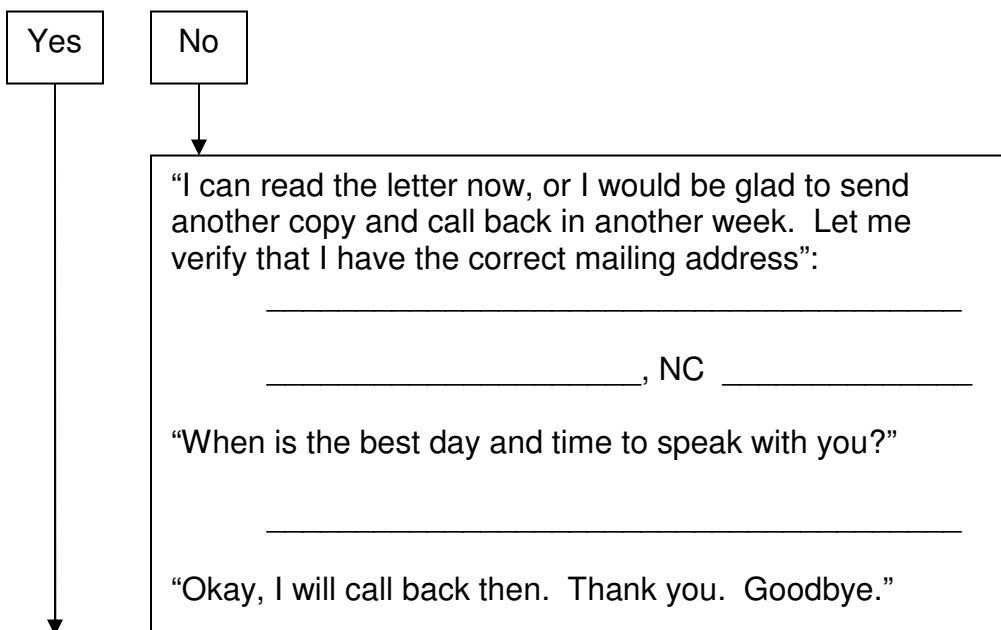
Workplace Name: \_\_\_\_\_

Workplace Phone Number: \_\_\_\_\_

“Hello, my name is Kelly Gurka from the University of North Carolina at Chapel Hill. I am calling to speak with \_\_\_\_\_. Is he/she available?”



“\_\_\_\_\_, I am calling from the University of North Carolina at Chapel Hill about a study of workplace violence. Have you received the letter explaining my study?”



“Okay, good. Was your business at \_\_\_\_\_ during \_\_\_\_\_ [time frame]?”

Yes	No
-----	----

↓

↓

“Then, what was the address during this time frame?”

\_\_\_\_\_

\_\_\_\_\_, NC \_\_\_\_\_

“What county is the business in?” \_\_\_\_\_

“And, were you working at this business during \_\_\_\_\_ [time frame]?”

Yes	No
-----	----

↓

↓

“When did you start working at the business?” \_\_\_\_\_

“And, do you know of a manager, owner, or employee who was working there during \_\_\_\_\_ [time frame]?”

Yes	No
-----	----

↓

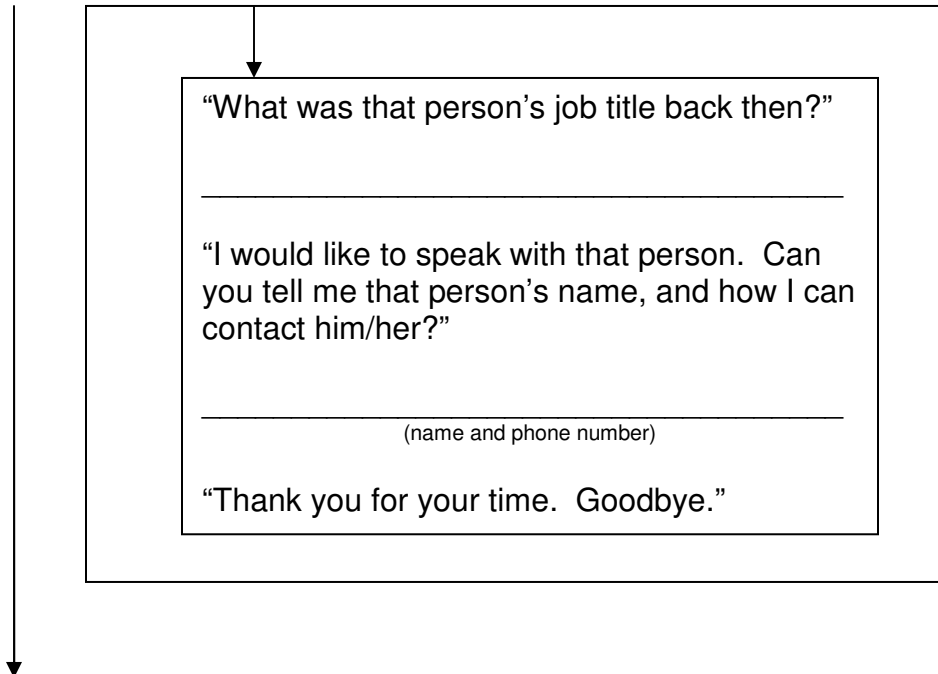
↓

“Do you know of anyone who could direct me to a worker from that time period?”

\_\_\_\_\_

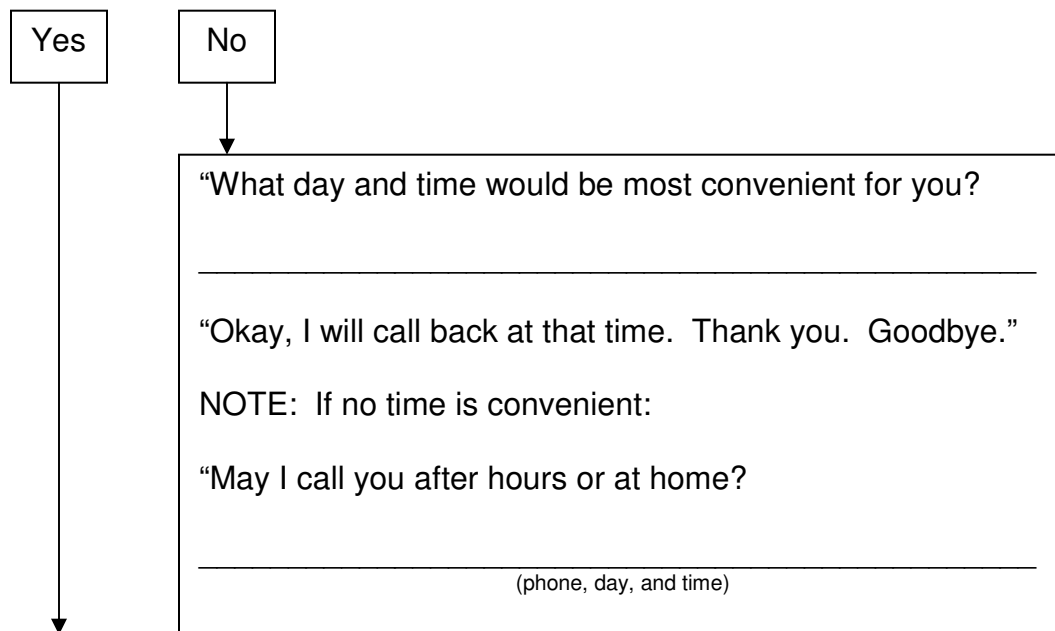
(name and phone number)





“What was your job title back then?” \_\_\_\_\_

“As stated in the letter, I am calling businesses in North Carolina which have experienced a homicide at their workplace. I want to learn about various workplace strategies being used to prevent workplace violence. The interview will take about 20 minutes. Is this a convenient time for you to proceed with the interview?”



“Okay, then let’s begin.”

## APPENDIX E

Univariate Results For Individual Strategy Variables

	<u>All Workplaces</u>		<u>Cases</u>		<u>Controls</u>		OR	Exact 95% CI
	n = 265	%	n = 55	%	n = 210	%		
Physical barriers*	107 / 115	93.0	13 / 14	92.9	94 / 101	93.1	0.97	0.11 46.94
External employee visibility	150 / 263	56.8	24 / 53	45.3	126 / 210	60.0	0.55	0.29 1.06
Exterior lighting	208 / 261	79.7	43 / 52	82.7	165 / 209	79.0	1.27	0.56 3.20
Access to workplace								
Entrances closed to public – after hours	212 / 259	81.9	34 / 49	69.4	178 / 210	84.8	0.41	0.19, 0.90
Entrances locked during work hours	26 / 260	10.0	4 / 51	7.8	22 / 209	10.5	0.72	0.17, 2.28
Swipe cards used	8 / 260	3.1	3 / 51	5.9	5 / 209	2.4	2.55	0.38, 13.57
ID badges worn	52 / 262	19.9	14 / 52	26.9	38 / 210	18.1	1.67	0.76, 3.53
Sign-in procedures employed	46 / 260	17.7	17 / 50	34.0	29 / 210	13.8	3.22	1.47, 6.83
Signs restricting access posted	100 / 257	38.9	23 / 47	48.9	77 / 210	36.7	1.66	0.83, 3.29
One or more policies limiting access	233 / 259	90.0	42 / 49	85.7	191 / 210	91.0	0.60	0.22, 1.79
Security devices								
Any security camera	42 / 258	16.3	9 / 50	18.0	33 / 208	15.9	1.16	0.45, 2.74
Working security camera	41 / 258	15.9	8 / 50	16.0	33 / 208	15.9	1.01	0.38, 2.44
Alarm alerting police or security guards	59 / 256	23.1	5 / 51	9.8	54 / 205	26.3	0.30	0.09, 0.82
Mirrors for security purposes	53 / 262	20.2	9 / 52	17.3	44 / 210	21.0	0.79	0.31, 1.81
Any one or more of these devices	113 / 256	44.1	16 / 50	32.0	97 / 206	47.1	0.53	0.27, 1.02
Alarm or mirror	99 / 257	38.5	13 / 51	25.5	86 / 206	41.8	0.48	0.24, 0.95

	<u>All Workplaces</u>		<u>Cases</u>		<u>Controls</u>		OR	Exact 95% CI
	n = 265	%	n = 55	%	n = 210	%		
<b>Employee training</b>								
How to avoid attack in parking lot	71 / 244	29.1	7 / 34	20.6	64 / 210	30.5	0.59	0.21, 1.49
How to respond to hostile co-workers	73 / 243	30.0	15 / 35	42.9	58 / 208	27.9	1.94	0.86, 4.29
How to respond to hostile customers	120 / 245	49.0	15 / 36	41.7	105 / 209	50.2	0.71	0.32, 1.53
Self-defense	12 / 244	4.9	4 / 36	11.1	8 / 208	3.9	3.13	0.65, 12.43
One or more training topics covered	141 / 248	56.9	21 / 38	55.3	120 / 210	57.1	0.93	0.44, 1.99
<b>Workplace policies</b>								
Handling threats from intimate partners	54 / 248	21.8	13 / 38	34.2	41 / 210	19.5	2.14	0.92, 4.79
Handling threats from strangers	75 / 246	30.5	13 / 36	36.1	62 / 210	29.5	1.35	0.59, 2.98
One or both policies	86 / 248	34.7	16 / 38	42.1	70 / 210	33.3	1.45	0.67, 3.11
<b>Staffing practices</b>								
Employees ever work alone	158 / 256	61.7	22 / 47	46.8	136 / 209	65.1	0.47	0.24, 0.94
Security guard at entrance	20 / 263	7.6	9 / 53	17.0	11 / 210	5.2	3.70	1.26, 10.44
Receptionist at entrance	94 / 264	35.6	26 / 54	48.2	68 / 210	32.4	1.94	1.00, 3.72

\* Only workplaces in the retail industry (n = 135) were considered for this recommendation.

APPENDIX F

Potential Confounder – Prior-Relationship Homicide Associations

Potential Confounder	OR	95% CI
Hours of operation, i.e. when employees are present	0.47	0.24, 0.95
Days only (7 am to 6 pm)	1.07	0.57, 2.02
Any evening hours (6 pm to 9 pm)	3.92	2.02, 7.61
Any night hours (9 pm to 6 am)	0.66	0.31, 1.40
Monday – Friday only	1.23	0.60, 2.52
Any Saturday hours	1.57	0.84, 2.93
Any Sunday hours	1.35	0.64, 2.81
Any weekend hours	4.39	2.23, 8.62
Friday night hours	3.57	1.87, 6.81
Saturday night hours	1.14	0.60, 2.15
Evening weekend hours	3.52	1.83, 6.79
Night weekend hours	3.59	1.70, 7.56
Ever open 24 hours	3.63	0.23, 0.65
Open 24-7		
Contact with the public		
Questionnaire element 37	0.82	0.38, 1.79
Questionnaire element 81	0.65	0.32, 1.34
Business size		
Business with 10 or fewer employees	0.50	0.26, 0.96
Business with 7 or fewer employees	0.40	0.20, 0.79
Time at current location		
2 years or less	2.30	0.75, 7.07
Type of location		
Enclosed shopping mall	0.63	0.07, 5.34
Non-enclosed strip shopping center	0.42	0.12, 1.47
Business or commercial district	1.07	0.55, 2.09
Residential area	1.50	0.82, 2.74
Industrial park	4.02	1.61, 10.04
Rural area	0.87	0.44, 1.72
Ethnicity and race of employees		
All White	0.46	0.22, 0.93
Any African-American	2.10	1.05, 4.22
Any Asian	5.10	2.04, 12.79
Any Hispanic	4.26	1.81, 10.03
Any minority	2.46	1.21, 5.02

APPENDIX G

Physical Barriers Analysis Report

UNIVARIATE ANALYSIS:

	Total n (%)	Cases n (%)	Controls n (%)
Retail Industry	133	17 (12.8)	116 (87.2)
Barriers (retail only)	115 / 133 (86.5)	13 / 14 (92.9)	94 / 101 (93.1)

	Cases	Controls	
Barrier	13	94	107
No barrier	1	7	8
	14	101	115

OR = 0.97  
Exact 95% CI: 0.11, 46.94

Missing: 18

ANALYSIS OF POTENTIAL CONFOUNDERS:

Association Between Potential Confounders and Outcome

Potential Confounder	OR	95% CI
Any night hours (9 pm to 6 am)	3.92	2.02, 7.61
Open to the public	0.65	0.32, 1.34
Business with 7 or fewer employees	0.40	0.20, 0.79
Two years or less at current location	2.30	0.75, 7.07
Located in an industrial park	4.02	1.61, 10.0
Any minority employees	2.46	1.21, 5.02

Association Between Potential Confounder and Exposure

Potential Confounder	OR	Exact 95% CI
Any night hours (9 pm to 6 am)	∞	1.49, ∞
Open to the public	15.14	0.17, 1199
Business with 7 or fewer employees	0.84	0.12, 4.58
Two years or less at current location	∞	0.04, ∞
Located in an industrial park	0.13	0.01, 8.98
Any minority employees	1.12	0.18, 8.02

MULTIVARIATE ANALYSIS:

	OR	95% Exact CI
Crude estimate	0.97	0.11, 46.95
Controlling for night hours	0.12	0.001, 9.80
Controlling for open to the public	0.84	0.09, 41.51
Controlling for ≤ 7 employees	0.66	0.07, 32.74
Controlling for business at location ≤ 2 years	0.78	0.08, 38.52
Controlling for located in an industrial park	0.85	0.09, 41.96
Controlling for having any minority employee	0.97*	0.13, ∞
Controlling for night hours, open to public	0.12*	0.001, 9.80
Controlling for night hours, ≤ 7 employees	0.12*	0, 4.83
Controlling for night hours, at location ≤ 2 years	0.11	0.001, 9.26
Controlling for night hours, in industrial park	0.10	0.001, 8.71
Controlling for night hours, minority employees	†	†
Controlling for night hours, industrial park, open to public	0.10	0.001, 8.71
Controlling for night hours, industrial park, ≤ 7 employees	0.12*	0, 4.56
Controlling for night hours, industrial park, at location ≤ 2 years	0.09	0.001, 8.08
Controlling for night hours, industrial park, at location ≤ 2 years, open to public	0.09	0.001, 8.10
Controlling for night hours, industrial park, at location ≤ 2 years, ≤ 7 employees	0.11*	0, 4.23
Controlling for night hours, industrial park, at location ≤ 2 years, open to public, ≤ 7 employees	0.11*	0, 4.29

\* Median unbiased estimate

† Conditional distribution is degenerate; thus, no estimates provided.

ASSOCIATION WITH HISTORY OF VIOLENCE IN THE WORKPLACE:

	Barrier	No Barrier	
Hx of Violence	31	2	33
No Reported Hx of Violence	66	5	71
	97	7	104

OR = 1.17  
Exact 95% CI: 0.18, 12.96

Missing: 29

ASSOCIATION BETWEEN EXTERNAL VISIBILITY AND HOMICIDE STRATIFIED BY HISTORY OF VIOLENCE

Analysis could not be conducted due to zero cell count.

APPENDIX H

External Visibility of Employees Analysis Report

UNIVARIATE ANALYSIS:

	Total n (%)	Cases n (%)	Controls n (%)
Employees visible from outside building	150 / 263 (57.0)	24 / 53 (45.3)	126 / 210 (60.0)

	Cases	Controls	
Employees Visible	24	126	150
Employees Not Visible	29	84	113
	53	210	263

OR = 0.55  
Exact 95% CI: 0.30, 1.01

Missing: 2

ANALYSIS OF POTENTIAL CONFOUNDERS:

Association between Potential Confounders and Exposure

Potential Confounder	OR	Exact 95% CI
Any night hours (9 pm to 6 am)	0.86	0.51, 1.44
Open to the public	4.03	2.03, 7.98
Business with 7 or fewer employees	2.21	1.33, 3.68
Two years or less at current location	0.48	0.17, 1.40
Located in an industrial park	0.21	0.07, 0.59
Any minority employees	0.43	0.26, 0.72

Association between Potential Confounders and Outcome

Potential Confounder	OR	95% CI
Any night hours (9 pm to 6 am)	3.92	2.02, 7.61
Open to the public	0.65	0.32, 1.34
Business with 7 or fewer employees	0.40	0.20, 0.79
Two years or less at current location	2.30	0.75, 7.07
Located in an industrial park	4.02	1.61, 10.0
Any minority employees	2.46	1.21, 5.02



MULTIVARIATE ANALYSIS:

Exact estimates from logistic regression utilizing forward selection.

	OR	% Δ	Exact 95% CI	CI Width
Crude estimate	0.55		0.29, 1.06	3.66
Controlling for night hours	0.51	7.27	0.25, 1.05	4.20
Controlling for open to the public	0.56	1.82	0.28, 1.11	3.96
Controlling for ≤ 7 employees	0.58	5.45	0.27, 1.22	4.52
Controlling for business at location ≤ 2 years	0.51	7.27	0.25, 1.02	4.08
Controlling for located in an industrial park	0.65	18.18	0.33, 1.29	3.91
Controlling for having any minority employee	0.56	1.82	0.26, 1.18	4.54
Controlling for industrial park, night hours	0.60	7.69	0.28, 1.26	4.50
Controlling for industrial park, open to public	0.63	3.08	0.31, 1.28	4.13
Controlling for industrial park, ≤ 7 employees	0.67	3.08	0.31, 1.46	4.71
Controlling for industrial park, ≤ 2 years	0.58	10.77	0.28, 1.21	4.32
Controlling for industrial park, minority employee	0.65	0	0.29, 1.43	4.93
Controlling for industrial park, ≤ 2 years, night hours	0.59	1.72	0.26, 1.32	5.08
Controlling for industrial park, ≤ 2 years, open to public	0.61	5.17	0.29, 1.31	4.52
Controlling for industrial park, ≤ 2 years, ≤ 7 employees	0.72	24.14	0.31, 1.64	5.29
Controlling for industrial park, ≤ 2 years, minority employee	0.68	17.24	0.29, 1.59	5.48
Controlling for ind park, ≤ 2 yrs, ≤ 7 empls, night hours	0.67	6.94	0.28, 1.64	5.86
Controlling for ind park, ≤ 2 yrs, ≤ 7 empls, open to public	0.72	0	0.31, 1.68	5.42
Controlling for ind park, ≤ 2 yrs, ≤ 7 empls, minorities	0.78	8.33	0.33, 1.86	5.64

NOTE: The percent change from 0.55 to 0.72 is 30.91%.

ASSOCIATION WITH HISTORY OF VIOLENCE IN THE WORKPLACE:

	Employees Visible	Employees Not Visible	
Hx of Violence	42	34	76
No Reported Hx of Violence	89	63	152
	131	97	228

OR = 0.87  
Exact 95% CI: 0.48, 1.59

Missing: 37

ASSN BETWEEN EXTERNAL VISIBILITY AND HOMICIDE STRATIFIED BY HX OF VIOLENCE:

OR<sub>Hx+</sub> = 0.57, Exact 95% CI: 0.22, 1.49      OR<sub>Hx-</sub> = 0.38, Exact 95% CI: 0.11, 1.35

APPENDIX I

External Lighting Analysis Report

UNIVARIATE ANALYSIS:

	Total n (%)	Cases n (%)	Controls n (%)
Good external lighting	208 / 261 (79.7)	43 / 52 (82.7)	165 / 209 (79.0)

	Cases	Controls	
External lighting	43	165	208
No external lighting	9	44	53
	52	209	261

OR = 1.27  
Exact 95% CI: 0.58, 2.81

Missing: 4

ANALYSIS OF POTENTIAL CONFOUNDERS:

Association between Potential Confounders and Exposure

Potential Confounder	OR	95% CI
Any night hours (9 pm to 6 am)	1.68	0.85, 3.31
Open to the public	0.97	0.43, 2.16
Business with 7 or fewer employees	0.67	0.36, 1.25
Two years or less at current location*	3.73	0.54, 160.81
Located in an industrial park*	0.75	0.24, 2.76
Any minority employees	1.98	1.04, 3.78

\* Exact 95% CI reported due to limited sample size.

Association between Potential Confounders and Outcome

Potential Confounder	OR	95% CI
Any night hours (9 pm to 6 am)	3.92	2.02, 7.61
Open to the public	0.65	0.32, 1.34
Business with 7 or fewer employees	0.40	0.20, 0.79
Two years or less at current location	2.30	0.75, 7.07
Located in an industrial park	4.02	1.61, 10.0
Any minority employees	2.46	1.21, 5.02

MULTIVARIATE ANALYSIS:

Exact estimates from logistic regression utilizing forward selection.

	OR	% Δ	Exact 95% CI	CI Width
Crude estimate	1.27		0.56, 3.20	5.71
Controlling for night hours	1.54	21.26	0.57, 4.86	8.53
Controlling for open to the public	1.43	12.60	0.61, 3.77	6.18
Controlling for ≤ 7 employees	1.03	18.90	0.42, 2.81	6.69
Controlling for business at location ≤ 2 years	1.43	12.60	0.58, 4.08	7.03
Controlling for located in an industrial park	1.33	4.72	0.57, 3.41	5.98
Controlling for having any minority employee	1.30	2.36	0.48, 4.08	8.50
Controlling for night hours, open to the public	1.55	0.65	0.58, 4.88	8.41
Controlling for night hours, ≤ 7 employees	1.16	24.68	0.42, 3.77	8.98
Controlling for night hours, business at location ≤ 2 years	1.58	2.60	0.54, 5.65	10.46
Controlling for night hours, located in an industrial park	1.52	1.30	0.56, 4.82	8.61
Controlling for night hours, any minority employee	1.41	8.44	0.48, 5.07	10.56
Controlling for night hours, ≤ 7 employees, open to public	1.17	3.54	0.42, 3.76	8.95
Controlling for night hours, ≤ 7 employees, at location ≤ 2 yrs	1.13	0	0.37, 4.14	11.19
Controlling for night hours, ≤ 7 employees, industrial park	1.17	3.54	0.42, 3.78	9.00
Controlling for night hours, ≤ 7 employees, any minority employee	1.40	23.89	0.47, 5.07	10.79
Controlling for night hrs, ≤ 7 empls, minorities, open to public	1.40	0	0.47, 5.06	10.77
Controlling for night hrs, ≤ 7 empls, minorities, location ≤ 2 yrs	1.39	0.71	0.44, 4.41	10.02
Controlling for night hrs, ≤ 7 empls, minorities, industrial park	1.37	2.14	0.41, 5.96	14.54

NOTE: The percent change from 1.27 to 1.40 is 10.24%.

ASSOCIATION WITH HISTORY OF VIOLENCE IN THE WORKPLACE:

	Employees Visible	Employees Not Visible	
Hx of Violence	61	14	75
No Reported Hx of Violence	124	28	152
	185	42	227

OR = 0.98  
Exact 95% CI: 0.48, 2.00

Missing: 38

ASSN BETWEEN EXTERNAL LIGHTING AND HOMICIDE STRATIFIED BY HX OF VIOLENCE:

OR<sub>Hx+</sub> = 9.03, Exact 95% CI: 1.18, 398.70 OR<sub>Hx-</sub> = 1.02, Exact 95% CI: 0.19, 10.23

APPENDIX J

Alarm or Mirror Analysis Report

UNIVARIATE ANALYSIS:

	Total n (%)	Cases n (%)	Controls n (%)
Use security alarms or mirrors	99 / 257 (38.5)	13 / 51 (25.5)	86 / 120 (41.8)

	Cases	Controls	
Mirror and/or alarm	13	86	99
No mirror or alarm	38	120	158
	51	206	257

OR = 0.48  
95% CI: 0.24, 0.95

Missing: 8

ANALYSIS OF POTENTIAL CONFOUNDERS:

Association between Potential Confounders and Exposure

Potential Confounder	OR	95% CI
Any night hours (9 pm to 6 am)	1.96	1.15, 3.32
Open to the public	2.67	1.25, 5.67
Business with 7 or fewer employees	0.95	0.57, 1.59
Two years or less at current location	0.37	0.10, 1.35
Located in an industrial park	1.07	0.42, 2.72
Any minority employees	1.52	0.90, 2.55

Association between Potential Confounders and Outcome

Potential Confounder	OR	95% CI
Any night hours (9 pm to 6 am)	3.92	2.02, 7.61
Open to the public	0.65	0.32, 1.34
Business with 7 or fewer employees	0.40	0.20, 0.79
Two years or less at current location	2.30	0.75, 7.07
Located in an industrial park	4.02	1.61, 10.0
Any minority employees	2.46	1.21, 5.02

MULTIVARIATE ANALYSIS:

Exact estimates from logistic regression utilizing forward selection.

	OR	% Δ	Exact 95% CI	CI Width
Crude estimate	0.48		0.22, 0.99	4.50
Controlling for night hours	0.31	35	0.13, 0.70	5.38
Controlling for open to the public	0.52	8	0.24, 1.09	4.54
Controlling for ≤ 7 employees	0.32	33	0.12, 0.76	6.33
Controlling for business at location ≤ 2 years	0.48	0	0.21, 1.04	4.95
Controlling for located in an industrial park	0.46	4	0.21, 0.96	4.57
Controlling for having any minority employee	0.30	38	0.11, 0.73	6.64
Controlling for any minority employee, night hours	0.24	50	0.09, 0.62	6.89
Controlling for any minority employee, open to the public	0.30	38	0.11, 0.74	6.73
Controlling for any minority employee, ≤ 7 employees	0.31	35	0.12, 0.77	6.42
Controlling for any minority employee, at location ≤ 2 years	0.33	31	0.11, 0.83	7.55
Controlling for any minority employee, located in industrial park	0.30	38	0.11, 0.73	6.64
Controlling for minority employee, night hours, open to public	0.25	48	0.09, 0.64	7.11
Controlling for minority employee, night hours, ≤ 7 employees	0.27	44	0.09, 0.69	7.67
Controlling for minority employee, night hours, at location ≤ 2 years	0.23	52	0.08, 0.63	7.88
Controlling for minority employee, night hours, industrial park	0.24	50	0.08, 0.61	7.63

ASSOCIATION WITH HISTORY OF VIOLENCE IN THE WORKPLACE:

	Mirror and/or alarm	No mirrors or alarms	
Hx of Violence	36	38	74
No Reported Hx of Violence	49	101	150
	85	139	224

OR = 1.95  
95% CI: 1.11, 3.45

Missing: 41

ASSN BETWEEN ALARMS AND MIRRORS AND HOMICIDE STRATIFIED BY HX OF VIOLENCE:

OR<sub>Hx+</sub> = 0.35, Exact 95% CI: 0.11, 1.08      OR<sub>Hx-</sub> = 0.19, Exact 95% CI: 0.004, 1.42

APPENDIX K

Access to Workplace Analysis Report

Locked Entrances (entrances locked during work hrs and/or after hrs)

UNIVARIATE ANALYSIS:

	Total n (%)	Cases n (%)	Controls n (%)
Locked entrances	212 / 259	34 / 49 (69.4)	178 / 210 (84.8)

	Cases	Controls	
Locked entrances	34	178	212
Entrances open	15	32	47
	49	210	259

OR = 0.41  
Exact 95% CI: 0.19, 0.90

Missing: 6

ANALYSIS OF POTENTIAL CONFOUNDERS:

Association between Potential Confounders and Exposure

Potential Confounder	OR	95% CI
Any night hours (9 pm to 6 am)	0.81	0.42, 1.55
Open to the public	0.65	0.26, 1.63
Business with 7 or fewer employees	1.98	1.02, 3.85
Two years or less at current location	0.86	0.23, 3.20
Located in an industrial park*	1.20	0.32, 6.68
Any minority employees	0.82	0.43, 1.55

\* Exact confidence interval reported due to limited sample size.

Association between Potential Confounders and Outcome

Potential Confounder	OR	95% CI
Any night hours (9 pm to 6 am)	3.92	2.02, 7.61
Open to the public	0.65	0.32, 1.34
Business with 7 or fewer employees	0.40	0.20, 0.79
Two years or less at current location	2.30	0.75, 7.07
Located in an industrial park	4.02	1.61, 10.0
Any minority employees	2.46	1.21, 5.02

MULTIVARIATE ANALYSIS:

Exact Estimates from Logistic Regression Utilizing Forward Selection

	OR	% Δ	Exact 95% CI	CI Width
Crude estimate	0.41	--	0.19, 0.90	4.74
Controlling for night hours	0.40	2.44	0.17, 0.94	5.53
Controlling for open to the public	0.43	4.88	0.20, 0.97	4.85
Controlling for ≤ 7 employees	0.44	7.32	0.19, 1.05	5.53
Controlling for business at location ≤ 2 years	0.49	19.51	0.21, 1.16	5.52
Controlling for located in an industrial park	0.39	4.88	0.18, 0.88	4.89
Controlling for having any minority employee	0.33	19.51	0.15, 0.78	5.20
Controlling for at location ≤ 2 years, night hours	0.45	8.16	0.19, 1.12	5.89
Controlling for at location ≤ 2 years, open to the public	0.48	2.04	0.21, 1.14	5.43
Controlling for at location ≤ 2 years, ≤ 7 employees	0.51	4.08	0.21, 1.30	6.19
Controlling for at location ≤ 2 years, located in an industrial park	0.46	6.12	0.20, 1.11	5.55
Controlling for at location ≤ 2 years, any minority employee	0.36	26.53	0.15, 0.90	6.00
Controlling for location ≤ 2 years, minority employee, night hours	0.34	5.56	0.13, 0.89	6.85
Controlling for location ≤ 2 years, minority employee, open to public	0.35	2.78	0.14, 0.87	6.21
Controlling for location ≤ 2 years, minority employee, ≤ 7 employees	0.44	22.22	0.18, 1.14	6.33
Controlling for location ≤ 2 years, minority employee, industrial park	0.34	5.56	0.14, 0.85	6.07
Controlling for location ≤ 2 yrs, minorities, ≤ 7 emps, night hrs	0.40	9.09	0.15, 1.07	7.13
Controlling for location ≤ 2 yrs, minorities, ≤ 7 emps, open to pub	0.43	2.27	0.17, 1.11	6.53
Controlling for location ≤ 2 yrs, minorities, ≤ 7 emps, ind park	0.41	6.82	0.16, 1.06	6.63

NOTE: Percent change from 0.41 to 0.44 is 6.82%.

ASSOCIATION WITH HISTORY OF VIOLENCE IN THE WORKPLACE:

	Entrances Locked	Entrances Open	
Hx of Violence	60	16	76
No Reported Hx of Violence	128	22	150
	188	38	226

OR = 0.64  
95% CI: 0.32, 1.32

Missing: 39

ASSN BETWEEN LOCKED ENTRANCES AND HOMICIDE STRATIFIED BY HX OF VIOLENCE:

OR<sub>Hx+</sub> = 0.60, Exact 95% CI: 0.17, 2.02      OR<sub>Hx-</sub> = 0.31, Exact 95% CI: 0.06, 2.11

## Access Limiting Practices Analysis

### UNIVARIATE ANALYSIS:

	Total n (%)	Cases n (%)	Controls n (%)
Access limiting practices	137 / 257 (53.3)	32 / 48 (66.7)	105 / 209 (50.2)

	Cases	Controls	
Access limited	32	105	137
No access limiting	16	104	120
	48	209	257

OR = 1.98  
95% CI: 1.03, 3.83

Missing: 8

### ANALYSIS OF POTENTIAL CONFOUNDERS:

#### Association between Potential Confounders and Exposure

Potential Confounder	OR	95% CI
Any night hours (9 pm to 6 am)	1.93	1.13, 3.29
Open to the public	0.76	0.40, 1.45
Business with 7 or fewer employees	0.27	0.16, 0.46
Two years or less at current location	0.41	0.13, 1.22
Located in an industrial park	2.16	0.80, 5.82
Any minority employees	2.46	1.47, 4.12

#### Association between Potential Confounders and Outcome

Potential Confounder	OR	95% CI
Any night hours (9 pm to 6 am)	3.92	2.02, 7.61
Open to the public	0.65	0.32, 1.34
Business with 7 or fewer employees	0.40	0.20, 0.79
Two years or less at current location	2.30	0.75, 7.07
Located in an industrial park	4.02	1.61, 10.0
Any minority employees	2.46	1.21, 5.02



MULTIVARIATE ANALYSIS:

Exact Estimates from Logistic Regression Utilizing Forward Selection

	OR	% Δ	Exact 95% CI	CI Width
Crude estimate	1.98	--	0.98, 4.10	4.18
Controlling for night hours	2.05	3.54	0.93, 4.75	5.11
Controlling for open to the public	1.88	5.05	0.93, 3.92	4.22
Controlling for ≤ 7 employees	1.39	29.80	0.63, 3.18	5.05
Controlling for business at location ≤ 2 years	1.90	4.04	0.90, 4.14	4.60
Controlling for located in an industrial park	1.83	7.58	0.90, 3.84	4.27
Controlling for having any minority employee	1.37	30.81	0.62, 3.12	5.03
Controlling for any minority employee, night hours	1.65	20.44	0.69, 4.09	5.93
Controlling for any minority employee, open to the public	1.36	0.73	0.61, 3.09	5.07
Controlling for any minority employee, ≤ 7 employees	1.17	14.60	0.51, 2.74	5.37
Controlling for any minority employee, at location ≤ 2 years	1.43	4.38	0.61, 3.46	5.67
Controlling for any minority employee, located in industrial park	1.33	2.92	0.60, 3.04	5.07
Controlling for any minority employee, night hours, open to public	1.60	3.03	0.67, 3.97	5.93
Controlling for any minority employee, night hours, ≤ 7 employees	1.44	12.73	0.59, 3.68	6.24
Controlling for any minority employee, night hours, at location ≤ 2 yrs	1.46	11.52	0.60, 3.73	6.22
Controlling for any minority employee, night hours, industrial park	1.50	9.09	0.62, 3.77	6.08
Controlling for minorities, night hours, ≤ 7 emps, open to public	1.41	2.08	0.57, 3.61	6.33
Controlling for minorities, night hrs, ≤ 7 emps, at location ≤ 2 yrs	1.27	11.81	0.50, 3.33	6.66
Controlling for minorities, night hours, ≤ 7 emps, industrial park	1.34	6.94	0.54, 3.45	6.39
Controlling for mins, night hrs, ≤ 7 emps, ≤ 2 yrs old, open to pub	1.24	2.36	0.49, 3.26	6.65
Controlling for mins, night hrs, ≤ 7 emps, ≤ 2 yrs old, ind park	1.15	9.45	0.44, 3.07	6.98
Controlling for all six confounders	1.13	1.74	0.44, 3.02	6.86

ASSOCIATION WITH HISTORY OF VIOLENCE IN THE WORKPLACE:

	Access limited	Access not limited	
Hx of Violence	46	27	73
No Reported Hx of Violence	74	77	151
	120	104	224

OR = 1.77  
95% CI: 1.00, 3.14

Missing: 41

ASSN BETWEEN ACCESS LIMITING PRACTICES AND HOMICIDE STRATIFIED BY HX OF VIOL.:

OR<sub>Hx+</sub> = 1.67, Exact 95% CI: 0.53, 5.66  
15.97

OR<sub>Hx-</sub> = 2.58, Exact 95% CI: 0.56,

## APPENDIX L

### Training Analysis Report

#### Avoid Being Attacked in a Parking Lot

##### UNIVARIATE ANALYSIS:

	Total n (%)	Cases n (%)	Controls n (%)
Training program	71 / 244 (29)	7 / 34 (21)	64 / 210 (30)

	Cases	Controls	
Training +	7	64	71
Training -	27	146	173
	34	210	244

OR = 0.59  
95% CI: (0.24, 1.43)

Missing: 21

##### ANALYSIS OF POTENTIAL CONFOUNDERS:

#### Association between Potential Confounders and Exposure

Potential Confounder	OR	95% CI
Any night hours (9 pm to 6 am)	1.85	1.04, 3.28
Open to the public	1.76	0.80, 3.88
Business with 7 or fewer employees	1.04	0.60, 1.81
Two years or less at current location*	1.15	0.30, 3.87
Located in an industrial park*	0.73	0.17, 2.48
Any minority employees	1.75	0.99, 3.08

#### Association between Potential Confounders and Outcome

Potential Confounder	OR	95% CI
Any night hours (9 pm to 6 am)	3.92	2.02, 7.61
Open to the public	0.65	0.32, 1.34
Business with 7 or fewer employees	0.40	0.20, 0.79
Two years or less at current location	2.30	0.75, 7.07
Located in an industrial park	4.02	1.61, 10.0
Any minority employees	2.46	1.21, 5.02

MULTIVARIATE ANALYSIS:

Exact Estimates from Logistic Regression Utilizing Forward Selection

	OR	% Δ	Exact 95% CI	CI Width
Crude estimate	0.59		0.21, 1.49	7.10
Controlling for night hours	0.52	12	0.17, 1.37	8.06
Controlling for open to the public	0.64	8	0.22, 1.61	7.32
Controlling for ≤ 7 employees	0.63	7	0.22, 1.64	7.45
Controlling for business at location ≤ 2 years	0.65	10	0.22, 1.67	7.59
Controlling for located in an industrial park	0.63	7	0.22, 1.62	7.36
Controlling for having any minority employee	0.57	3	0.19, 1.48	7.79
Controlling for night hours, open to the public	0.55	7	0.18, 1.45	8.06
Controlling for night hours, ≤ 7 employees	0.57	3	0.19, 1.57	8.26
Controlling for night hours, business at location ≤ 2 years	0.55	7	0.18, 1.49	8.28
Controlling for night hours, located in an industrial park	0.53	10	0.18, 1.39	7.72
Controlling for night hours, having any minority employee	0.57	3	0.19, 1.54	8.11
Controlling for night hrs, industrial park, open to public	0.55	7	0.18, 1.46	8.11
Controlling for night hrs, industrial park, ≤ 7 employees	0.58	2	0.19, 1.59	8.37
Controlling for night hrs, industrial park, at location ≤ 2 years	0.56	5	0.18, 1.53	8.50
Controlling for night hrs, industrial park, minority employees	0.58	2	0.19, 1.58	8.32

ASSOCIATION WITH HISTORY OF VIOLENCE IN THE WORKPLACE:

	Training +	Training -	
Hx of Violence	26	43	69
No Reported Hx of Violence	39	109	148
	65	152	217

OR = 1.69  
95% CI: 0.92, 3.11

Missing:

ASSN BETWEEN TRAINING AND HOMICIDE STRATIFIED BY HX OF VIOLENCE:

OR<sub>Hx+</sub> = 0.95, Exact 95% CI: 0.27, 3.19

OR<sub>Hx-</sub> = \*, Exact 95% CI: \*

\* Zero cell count

## HANDLING HOSTILE COWORKERS

### UNIVARIATE ANALYSIS:

	Total n (%)	Cases n (%)	Controls n (%)
Training	73 (30)	15 (43)	58 (28)

	Cases	Controls	
Training +	15	58	73
Training -	20	150	170
	35	208	243

OR = 1.94  
95% CI: 0.93, 4.04

Missing: 22

### ANALYSIS OF POTENTIAL CONFOUNDERS:

#### Association between Potential Confounders and Exposure

Potential Confounder	OR	95% CI
Any night hours (9 pm to 6 am)	3.18	1.72, 5.88
Open to the public	0.90	0.45, 1.83
Business with 7 or fewer employees	0.60	0.34, 1.04
Two years or less at current location*	0.81	0.18, 2.88
Located in an industrial park	1.29	0.46, 3.62
Any minority employees	2.72	1.52, 4.87

\* Exact 95% CI

#### Association between Potential Confounders and Outcome

Potential Confounder	OR	95% CI
Any night hours (9 pm to 6 am)	3.92	2.02, 7.61
Open to the public	0.65	0.32, 1.34
Business with 7 or fewer employees	0.40	0.20, 0.79
Two years or less at current location	2.30	0.75, 7.07
Located in an industrial park	4.02	1.61, 10.0
Any minority employees	2.46	1.21, 5.02

MULTIVARIATE ANALYSIS:

Exact Estimates from Logistic Regression Utilizing Forward Selection

	OR	% Δ	Exact 95% CI	CI Width
Crude estimate	1.93		0.86, 4.29	4.99
Controlling for night hours	1.58	18	0.65, 3.78	5.82
Controlling for open to the public	1.92	1	0.85, 4.25	5.00
Controlling for ≤ 7 employees	1.82	6	0.79, 4.17	5.28
Controlling for business at location ≤ 2 years	1.84	5	0.77, 4.32	5.61
Controlling for located in an industrial park	2.01	4	0.87, 4.59	5.28
Controlling for having any minority employee	1.76	9	0.75, 4.09	5.45
Controlling for night hours, open to the public	1.57	19	0.65, 3.75	5.77
Controlling for night hours, ≤ 7 employees	1.60	17	0.64, 3.96	6.19
Controlling for night hours, at location ≤ 2 years	1.45	25	0.57, 3.62	6.35
Controlling for night hours, located in an industrial park	1.50	22	0.61, 3.63	5.95
Controlling for night hours, having any minority employee	1.74	10	0.70, 4.30	6.14
Controlling for night hrs, location ≤ 2 yrs, open to the public	1.46	24	0.57, 3.64	6.39
Controlling for night hrs, location ≤ 2 yrs, ≤ 7 employees	1.54	20	0.58, 4.01	6.91
Controlling for night hrs, location ≤ 2 yrs, in an industrial park	1.36	30	0.52, 3.45	6.63
Controlling for night hrs, location ≤ 2 yrs, any minority employee	1.63	16	0.62, 4.22	6.81

ASSOCIATION WITH HISTORY OF VIOLENCE IN THE WORKPLACE:

	Training +	Training -	
Hx of Violence	26	43	69
No Reported Hx of Violence	39	109	148
	65217	152	

OR = 1.69  
95% CI: 0.92, 3.11

Missing: 48

ASSN BETWEEN AND HOMICIDE STRATIFIED BY HX OF VIOLENCE:

OR<sub>Hx+</sub> = 0.95, Exact 95% CI: 0.32, 2.84

OR<sub>Hx-</sub> = \*, Exact 95% CI: \*

\* Zero cell count.

APPENDIX M

Staffing Practices Analysis Reports

Employees Ever Work Alone Analysis Report

UNIVARIATE ANALYSIS:

	Total n (%)	Cases n (%)	Controls n (%)
Employees ever work alone	158 / 256 (61.7)	22 / 47 (46.8)	136 / 209 (65.1)

	Cases	Controls	
Ever work alone	22	136	158
Never work alone	25	73	98
	47	209	256

OR = 0.47  
95% CI: 0.25, 0.90  
Missing: 9

ANALYSIS OF POTENTIAL CONFOUNDERS:

Association between Potential Confounders and Exposure

Potential Confounder	OR	95% CI
Any night hours (9 pm to 6 am)	0.47	0.28, 0.80
Open to the public	1.40	0.74, 2.21
Business with 7 or fewer employees	4.57	2.62, 7.98
Two years or less at current location	1.81	0.56, 5.87
Located in an industrial park	0.30	0.12, 0.79
Any minority employees	0.35	0.21, 0.60

Association between Potential Confounders and Outcome

Potential Confounder	OR	95% CI
Any night hours (9 pm to 6 am)	3.92	2.02, 7.61
Open to the public	0.65	0.32, 1.34
Business with 7 or fewer employees	0.40	0.20, 0.79
Two years or less at current location	2.30	0.75, 7.07
Located in an industrial park	4.02	1.61, 10.0
Any minority employees	2.46	1.21, 5.02

MULTIVARIATE ANALYSIS:

Exact Estimates from Logistic Regression Utilizing Forward Selection

	OR	% $\Delta^*$	% $\Delta^\dagger$	Exact 95% CI	CI Width
Crude estimate	0.47			0.24, 0.94	3.92
Controlling for night hours	0.59	26		0.28, 1.28	4.57
Controlling for open to the public	0.50	6		0.25, 1.01	3.88
Controlling for $\leq 7$ employees	0.66	40		0.30, 1.45	4.83
Controlling for business at location $\leq 2$ years	0.44	6		0.21, 0.91	4.33
Controlling for located in an industrial park	0.54	15		0.27, 1.10	4.07
Controlling for having any minority employee	0.54	15		0.24, 1.20	5.00
Controlling for $\leq 7$ empls, night hours	0.74	57	12	0.31, 1.80	5.81
Controlling for $\leq 7$ empls, open to public	0.66	40	0	0.30, 1.45	4.83
Controlling for $\leq 7$ empls, at location $\leq 2$ years	0.56	19	15	0.24, 1.30	5.42
Controlling for $\leq 7$ empls, located in an industrial park	0.69	47	5	0.31, 1.54	4.97
Controlling for $\leq 7$ empls, any minority employee	0.63	34	5	0.27, 1.43	5.30
Controlling for $\leq 7$ empls, night hrs, open to public	0.74	57	0	0.30, 1.78	
Controlling for $\leq 7$ empls, night hrs, at location $\leq 2$ years	0.64	30	14	0.25, 1.62	
Controlling for $\leq 7$ empls, night hrs, industrial park	0.78	66	5	0.32, 1.90	
Controlling for $\leq 7$ empls, night hrs, minority employee	0.68	45	8	0.27, 1.71	

\* percent change from crude estimate

† percent change from prior reduced model

ASSOCIATION WITH HISTORY OF VIOLENCE IN THE WORKPLACE:

	Ever Work Alone	Never Work Alone	
Hx of Violence	49	26	75
No Reported Hx of Violence	91	59	150
	140	95	225

OR = 1.22  
95% CI: 0.69, 2.18

Missing:

ASSN BETWEEN EVER WORK ALONE AND HOMICIDE STRATIFIED BY HX OF VIOLENCE:

OR<sub>Hx+</sub> = 0.55, Exact 95% CI: 0.18, 1.67  
0.77

OR<sub>Hx-</sub> = 0.14, Exact 95% CI: 0.01,

## Security Guard at Entrance Analysis Report

### UNIVARIATE ANALYSIS:

	Total n (%)	Cases n (%)	Controls n (%)
Security guard at entrance	20 / 263 (7.6)	9 / 53 (17.0)	11 / 210 (5.2)

	Cases	Controls	
Guard at entrance	9	11	20
No guard at entrance	44	199	243
	53	210	263

OR = 3.70

Exact 95% CI: 1.26, 10.44

Missing: 2

### ANALYSIS OF POTENTIAL CONFOUNDERS:

#### Association between Potential Confounders and Exposure

Potential Confounder	OR	95% CI
Any night hours (9 pm to 6 am)	7.55	2.42, 23.5
Open to the public*	0.44	0.15, 1.51
Business with 7 or fewer employees	0.17	0.05, 0.61
Two years or less at current location*	0.85	0.02, 6.27
Located in an industrial park*	2.21	0.38, 8.71
Any minority employees	5.18	1.45, 18.51

\* Exact estimates reported due to some expected cell counts of less than 5.

#### Association between Potential Confounders and Outcome

Potential Confounder	OR	95% CI
Any night hours (9 pm to 6 am)	3.92	2.02, 7.61
Open to the public	0.65	0.32, 1.34
Business with 7 or fewer employees	0.40	0.20, 0.79
Two years or less at current location	2.30	0.75, 7.07
Located in an industrial park	4.02	1.61, 10.0
Any minority employees	2.46	1.21, 5.02



MULTIVARIATE ANALYSIS:

Exact Estimates from Logistic Regression Utilizing Forward Selection

	OR	% Δ	Exact 95% CI	CI Width
Crude estimate	3.67	--	1.26, 10.4	8.25
Controlling for night hours	2.40	35	0.74, 7.47	10.09
Controlling for open to the public	3.23	12	1.06, 9.45	8.92
Controlling for ≤ 7 employees	2.58	30	0.77, 8.13	10.56
Controlling for business at location ≤ 2 years	3.82	4	1.24, 11.3	9.11
Controlling for located in an industrial park	3.45	6	1.15, 10.1	8.78
Controlling for having any minority employee	3.48	5	1.02, 11.3	11.08
Controlling for night hours, open to public	2.37	35	0.73, 7.37	10.10
Controlling for night hours, ≤ 7 employees	2.00	46	0.57, 6.61	11.60
Controlling for night hours, at location ≤ 2 years	2.31	37	0.67, 7.40	11.04
Controlling for night hours, located in an industrial park	2.12	42	0.65, 6.60	10.15
Controlling for night hours, any minority employee	2.59	29	0.73, 8.79	12.04
Controlling for night hours, ≤ 7 employees, open to public	1.97	46	0.56, 6.45	11.52
Controlling for night hours, ≤ 7 employees, at location ≤ 2 years	1.95	47	0.52, 6.65	12.79
Controlling for night hours, ≤ 7 employees, industrial park	1.84	50	0.52, 6.04	11.62
Controlling for night hours, ≤ 7 employees, minority employees	2.33	37	0.65, 8.00	12.50
Controlling night hrs, ≤ 7 emps, industrial park, open	1.85	50	0.53, 6.09	11.49
Controlling night hrs, ≤ 7 emps, industrial park, loc ≤ 2 yrs	1.78	51	0.47, 6.04	12.85
Controlling night hrs, ≤ 7 emps, industrial park, minorities	2.12	42	0.59, 7.19	12.19
Controlling night hrs, ≤ 7 emps, ind park, minority, open	2.11	43	0.59, 7.15	12.12
Controlling night hrs, ≤ 7 emps, ind park, minority, loc ≤ 2 yrs	2.04	44	0.53, 7.10	13.40
Controlling for all potential confounders	2.02	45	0.53, 6.98	13.17

ASSOCIATION WITH HISTORY OF VIOLENCE IN THE WORKPLACE:

	Guard at entrance	No guard at entrance	
Hx of Violence	10	65	75
No Reported Hx of Violence	5	147	152
	15	212	227

OR = 4.52  
95% CI: 1.49, 13.76  
Missing: 38

ASSN BETWEEN GUARD AT ENTRANCE AND HOMICIDE STRATIFIED BY HX OF VIOLENCE:

OR<sub>Hx+</sub> = 2.25, Exact 95% CI: 0.46, 10.88    OR<sub>Hx-</sub> = 0, Exact 95% CI: 0, 11.21  
(0 cell count)

## Receptionist at Entrance Analysis Report

### UNIVARIATE ANALYSIS:

	Total n (%)	Cases n (%)	Controls n (%)
Receptionist at entrance	94 / 264 (35.6)	26 / 54 (48.2)	68 / 210 (32.4)

	Cases	Controls	
Receptionist	26	68	94
No receptionist	28	142	170
	54	210	264

OR = 1.94  
95% CI: 1.06, 3.56

Missing: 1

### ANALYSIS OF POTENTIAL CONFOUNDERS:

#### Association between Potential Confounders and Exposure

Potential Confounder	OR	95% CI
Any night hours (9 pm to 6 am)	0.96	0.56, 1.65
Open to the public	0.45	0.24, 0.86
Business with 7 or fewer employees	0.20	0.11, 0.35
Two years or less at current location	2.12	0.74, 6.05
Located in an industrial park	5.19	1.94, 13.88
Any minority employees	2.97	1.72, 5.13

#### Association between Potential Confounders and Outcome

Potential Confounder	OR	95% CI
Any night hours (9 pm to 6 am)	3.92	2.02, 7.61
Open to the public	0.65	0.32, 1.34
Business with 7 or fewer employees	0.40	0.20, 0.79
Two years or less at current location	2.30	0.75, 7.07
Located in an industrial park	4.02	1.61, 10.0
Any minority employees	2.46	1.21, 5.02

MULTIVARIATE ANALYSIS:

Exact Estimates from Logistic Regression Utilizing Forward Selection

	OR	% Δ*	% Δ†	Exact 95% CI	CI Width
Crude estimate	1.93	--	--	1.01, 3.72	3.68
Controlling for night hours	1.63	16		0.78, 3.37	4.32
Controlling for open to the public	1.89	2		0.97, 3.70	3.81
Controlling for ≤ 7 employees	1.81	6		0.83, 3.93	4.73
Controlling for business at location ≤ 2 years	1.75	9		0.86, 3.52	4.09
Controlling for located in an industrial park	1.62	16		0.82, 3.20	3.90
Controlling for having any minority employee	1.95	1		0.91, 4.23	4.65
Controlling for industrial park, night hours	1.39	28	14	0.64, 2.95	4.61
Controlling for industrial park, open to public	1.61	17	1	0.80, 3.22	4.03
Controlling for industrial park, ≤ 7 employees	1.58	18	2	0.70, 3.51	5.01
Controlling for industrial park, ≤ 2 years at location	1.52	21	6	0.73, 3.14	4.30
Controlling for industrial park, minority employee	1.66	14	2	0.74, 3.68	4.97
Controlling for industrial park, night hours, open to public	1.49	23	7	0.68, 3.21	4.72
Controlling for industrial park, night hours, ≤ 7 employees	1.65	15	19	0.68, 3.98	5.85
Controlling for industrial park, night hours, ≤ 2 years at location	1.29	33	7	0.57, 2.86	5.02
Controlling for industrial park, night hours, minority employee	1.87	3	35	0.78, 4.49	5.76
Controlling for industrial park, night hrs, ≤ 2 years, open to public	1.30	33	1	0.57, 2.91	5.11
Controlling for industrial park, night hrs, ≤ 2 years, ≤ 7 employees	1.50	22	16	0.58, 3.85	6.66
Controlling for industrial park, night hrs, ≤ 2 years, minority employee	1.64	15	27	0.64, 4.19	6.55
Controlling for ind park, night hrs, ≤ 2 years, ≤ 7 emps, open to public	1.50	22	0	0.58, 3.86	6.66
Controlling for ind park, night hrs, ≤ 2 years, ≤ 7 emps, minority	1.59	18	6	0.59, 4.30	7.29

\* percent change from crude estimate

† percent change from prior reduced model

ASSOCIATION WITH HISTORY OF VIOLENCE IN THE WORKPLACE:

	Receptionist	No receptionist	
Hx of Violence	30	46	76
No Reported Hx of Violence	47	105	152
	77	151	228

OR = 1.46  
95% CI: 0.82, 2.59

Missing: 37

ASSN BETWEEN RECEPTIONIST AND HOMICIDE STRATIFIED BY HX OF VIOLENCE:

OR<sub>Hx+</sub> = 1.94, 95% CI: 0.74, 5.10

OR<sub>Hx-</sub> = 1.30, 95% CI: 0.36, 4.68

## APPENDIX N

### Discussion of Sources of Bias

#### *Residual confounding*

The study was subject to bias. Although I controlled for a number of confounding factors when estimating the effect of each prevention strategy on the odds of prior-relationship homicides, constructs we did not measure, and other variables not assessed as potential confounders, could have biased the results.

#### *Outcome misclassification*

Another source of bias could be misclassification. It is highly unlikely that we either missed case workplaces or that control workplaces participating in the study experienced a prior-relationship homicide in the month of its matched case homicide given our case ascertainment procedures. Moreover, it is more unlikely that workplaces identified as cases were erroneously classified as experiencing a workplace homicide when one did not occur. Thus, both nondifferential and differential misclassification of the outcome was highly unlikely. However, misclassifying prevention strategies could have occurred.

#### *Exposure misclassification*

Several sources of differential misclassification of exposure were possible in this study. Because homicide is a particularly salient event, recall bias could have occurred in which cases systematically over- or under- reported the presence of the various prevention strategies compared to controls. Perhaps managers of case workplaces were

more likely to recall what strategies were implemented at the time of the event, whereas, controls might have reported recent additions to their workplace violence prevention plan that were not, in fact, instituted at the time of the matched homicide. Social desirability may have affected respondents differently as well: managers of both case and control workplaces were perhaps more likely to report the use of certain prevention strategies compared to proxy informants, which were only utilized for case workplaces. Conversely, proxy respondents may have been more prone to reporting errors due to their less intimate knowledge of the work site and administrative policies instituted in the workplace.

#### *Sensitivity Analysis “Correcting” for Exposure Misclassification*

The first portion of the analysis hypothetically corrected for different levels of non-differential misclassification of exposure. The smallest values for both the sensitivity and the specificity were those for which the smallest whole number cell size was at least one, for you could not have negative subjects or a portion of a subject, and the odds ratio cannot be calculated with any cells having a value of zero.

For differential misclassification, I hypothesized that three different types of error could have occurred. First, police proxies may have failed to report the exposure because they did not know that the workplace had a particular security device or whether the workplace kept their entrances locked when employees were present (or after regular business hours if the workplace is open to the public). Because only proxy respondents were used for case workplaces, I only changed the value of the sensitivity (due to false negatives) for cases.

I also hypothesized that social desirability might cause either the case or control workplace managers to report more prevention strategies than they really had (false positives). Thus, I calculated corrected odds ratios in which the specificity was changed for both cases and controls. The specificity for cases, however, was always lower than that of controls because I thought case workplaces would be more affected. For the same reason, I also did a set in which I held the control specificity to one and only changed the case specificity.

Finally, I thought that perhaps control managers might be more likely to report recent improvements to the workplace occurring after the time of their matched homicide when compared to case managers because of the salient nature of a homicide. Again, I assumed no false positives among cases and three levels of specificity for controls, and I also considered three scenarios where both cases and controls reported recent improvements, but control managers always reported more false positives.

The corrected odds ratios and corresponding levels of sensitivity and specificity for both the cases and controls are shown in the following two tables: one for security devices and one for locking entrances.

Security Devices

Unadjusted, estimated OR = 0.53

Misclassification of Exposure	Cases		Controls		Corrected OR
	Se	Sp	Se	Sp	
Non-differential	0.75	1.00	0.75	1.00	0.50
	0.50	1.00	0.50	1.00	0.44
	0.25	1.00	0.25	1.00	0.07
	1.00	0.95	1.00	0.95	0.43
	1.00	0.90	1.00	0.90	0.27
	1.00	0.86	1.00	0.86	0.10
Differential	0.90	1.00	1.00	1.00	0.46
	0.75	1.00	1.00	1.00	0.36
	0.60	1.00	1.00	1.00	0.25
	1.00	0.90	1.00	0.95	0.59
	1.00	0.80	1.00	0.90	0.98
	1.00	0.77	1.00	0.87	1.33
	1.00	0.90	1.00	1.00	0.91
	1.00	0.80	1.00	1.00	3.33
	1.00	0.77	1.00	1.00	16.20
	1.00	0.95	1.00	0.90	0.20
	1.00	0.90	1.00	0.87	0.07
	1.00	1.00	1.00	0.95	0.34
	1.00	1.00	1.00	0.90	0.16
	1.00	1.00	1.00	0.87	0.04

Keeping Locked Entrances When Employees Present of After Regular Business Hours

Unadjusted, estimated OR = 0.41

Misclassification of Exposure	Cases		Controls		Corrected OR
	Se	Sp	Se	Sp	
Nondifferential	0.75	1.00	0.75	1.00	0.37
	0.50	1.00	0.50	1.00	0.27
	0.33	1.00	0.25	1.00	0.03
	1.00	0.95	1.00	0.95	0.33
	1.00	0.90	1.00	0.90	0.22
	1.00	0.85	1.00	0.85	0.05
Differential	0.80	1.00	1.00	1.00	0.35
	0.55	1.00	1.00	1.00	0.14
	0.33	1.00	1.00	1.00	0.01
	1.00	0.90	1.00	0.95	0.41
	1.00	0.80	1.00	0.90	0.41
	1.00	0.70	1.00	0.85	0.44
	1.00	0.90	1.00	1.00	0.59
	1.00	0.80	1.00	1.00	1.09
	1.00	0.70	1.00	1.00	1.46
	1.00	0.95	1.00	0.90	0.18
	1.00	0.90	1.00	0.85	0.04
	1.00	1.00	1.00	0.95	0.28
	1.00	1.00	1.00	0.90	0.15
	1.00	1.00	1.00	0.87	0.03

*Selection bias*

Selection bias could have also occurred. The controls to which cases were compared may not have represented the distribution of prevention strategies present in North Carolina workplaces comprising the source population from which case workplaces arose. Although incidence density sampling was utilized for control selection in the original study, I extended the case series and did not likewise extend the control group. I also included all of the original controls in the analysis when I limited the cases to those experiencing prior-relationship homicides. Controls were randomly sampled



from a theoretically complete list of workplaces in operation during the month of each workplace homicide occurring 1994 to 1998, but the controls were matched by major industrial sector. Matching controls to cases on any construct automatically introduces selection bias if the distribution of exposure(s) within the source population from which cases arose is not independent of the matching factor. We know that the distribution of workplaces to the industrial sectors for robbery-related crimes differs from that of prior-relationship homicides (Section 4.3). If industrial sectors implement prevention strategies differently, the estimate of the distribution of each strategy under examination may not accurately represent the distribution of that strategy in the source population for these cases. However, without knowing the joint distribution of the matching factors in the entire source population, we cannot adjust for any potential selection bias (67).

In addition, because control selection was not extended to correspond with cases occurring through 2003, any secular changes in the distribution of prevention strategies in North Carolina workplaces over time would not be represented in the control group. If the distribution of the presence of prevention strategies did change from 1998 through 2004, the results are likely biased because the true distribution of the case source population is not represented. However, research suggests that workplaces are not very likely to change their workplace violence prevention programs (40, 78). Thus, if little change was exacted in workplaces in North Carolina from 1998 – 2003, the resulting bias is likely small to negligible.

## APPENDIX O

Table 1. Association between prior-relationship workplace homicide and select attributes of the physical work site, North Carolina, 1994 – 2003.

	Adjusted*		Adjusted* + Industry	
	OR <sup>†</sup>	95% CI <sup>†</sup>	OR <sup>†</sup>	95% CI <sup>†</sup>
Physical barriers <sup>‡</sup>	--	--	--	--
Employee visibility	0.67	0.26, 1.73	0.79	0.28, 2.31
Exterior lighting	1.39	0.42, 6.01	1.33	0.40, 6.22
Security devices				
Security cameras	0.93	0.29, 2.69	1.20	0.34, 3.99
Alarms	0.24	0.05, 0.81	0.27	0.55, 0.99
Mirrors	0.43	0.10, 1.43	0.61	0.13, 2.42
Any of above	0.28	0.10, 0.73	0.35	0.11, 1.04

\* Adjusted for night hours of operation, small business size, at current location two years or fewer, located in an industrial park, and having any minority employees.

† OR, odds ratio; CI, confidence interval. Estimated using exact logistic regression.

‡ Only retail workplaces (n = 135) were included in the physical barriers analysis.

Table 2. Association between prior-relationship workplace homicide and select administrative policies, North Carolina, 1994 – 2003.

	Adjusted*		Adjusted* + Industry	
	OR	95% CI	OR	95% CI
Access policies				
Locked entrances	0.34	0.13, 0.92	0.41	0.14, 1.26
Limit access	1.35	0.51, 3.68	1.05	0.35, 3.18
Either of above policies	0.29	0.09, 1.08	0.25	0.06, 1.11
Employee training				
Attack in parking lot	0.62	0.20, 1.71	0.63	0.18, 2.02
Hostile co-workers	1.52	0.57, 4.00	2.04	0.70, 5.99
Hostile customers	0.77	0.29, 2.01	1.09	0.35, 3.46
Threats from intimates	1.58	0.54, 4.42	1.65	0.52, 4.99
Threats from strangers	0.83	0.28, 2.25	0.76	0.22, 2.41
One or more of above	0.90	0.33, 2.60	1.08	0.37, 3.38
Staffing practices				
Employees never work alone	2.02	0.74, 5.64	3.32	1.10, 10.72
Security guard at front	2.21	0.58, 7.76	2.43	0.55, 10.00
Receptionist at front	2.00	0.70, 5.79	1.25	0.38, 4.05
Any of above practices	2.60	0.78, 9.44	2.86	0.79, 11.36

\* Adjusted for night hours of operation, small business size, at current location two years or fewer, located in an industrial park, and having any minority employees.

† OR, odds ratio; CI, confidence interval. Estimated using exact logistic regression.

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