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# A prospective analysis of the outcomes of violent prone restraint incidents in policing

## Abstract

Placing a combative person in the prone position occurs numerous times daily throughout the country without the incident resulting in serious injury to the person, let alone a sudden death. In statistically rare incidents, the individual may unexpectedly and suddenly die within a short amount of time after restraint. Questions may arise which implicate the officers use of force measures asserting that placing the arrestee in the prone position caused the death. What remains unanswered in majority of the sudden in custody restraint incidents is the question of whether prone restraint caused the death. Using a prospective design, this study examined the outcomes of 1085 violent arrest incidents over 12 months with 17 police agencies in the United States. Male arrestees accounted for 85 percent and arrestees were placed in the prone position from about 1 to 5 minutes. About 84 percent of the arrestees exhibited behaviors resembling chemical substance use, psychiatric impairment, or both.

Police officers commonly used several force measures to control and restrain the arrestee including: empty-hand control techniques; a TASER; an aerosol; applying weight force on the back of the arrestee; a hobble strap; and handcuffs. None of the arrestees died during the study period and moderate injuries were sustained in 16 percent of the incidents and significant injuries were sustained in 4 percent. Arrestee's injuries were associated with their active behaviors of resistance during the arrest and continued resistance after restraint. Regression analysis revealed three predictive outcome models (p=0.001) showing the relationships among common variables when using the prone position revealing that arrestees rarely sustain an injury. The results show that the use of the prone position with violent arrestees is a safe restraint method and that the officers' use of force is rare.

**Keywords:** prone restraint, arrest-related death, police use of force, positional asphyxia, conducted energy weapon

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## Introduction

Law enforcement and emergency health care personnel frequently confront combative and violent individuals who require physical control and restraint. Frequently in these violent confrontations the individual exhibits behaviors consistent with being under the influence of a chemical substance or exhibits behaviors consistent with a mental illness, or both. To gain control of the individual police officers use varying physical control techniques and/or non-deadly force equipment such as aerosols, conducted energy weapons (CEW), impact weapons, bean bangs, projectiles, and other devices, depending on the circumstances. After an application of any of these measures, the individual will frequently be placed in the prone position by one or more officers in order to safely control and secure the person in handcuffs with their hands behind their back. One or more officers may place one or both knees on the resisting person's back or kneel next to the person in order to control the subject's hands for handcuffing. Depending on the nature of resistance, the person's ankles may also be restrained with a hobble strap. Infrequently the hobble strap may be also connected to the handcuffs placing the individual in the prone maximal restraint position (PMR).[1] Placing a combative person in the prone position occurs numerous times daily throughout the country without the incident resulting in serious injury to the person, let alone a sudden death.

In statistically rare incidents, the individual may unexpectedly become unresponsive and efforts to revive the person by officers or emergency medical personnel are unsuccessful, whereupon it is determined that the individual is dead all within a short amount of time after restraint. In a sudden custodial death case an autopsy may fail to show anatomic or toxicological results sufficient to explain death compounding the cause of death. Questions may arise as to whether the use of the CEW, an aerosol, other non-deadly devices used or whether physical control measures used by the officers or weight applied contributed to the death, or the combination of these measures contributed to the death. A medicolegal investigation, however, may show that it was neither of these components used, separately or in tandem that contributed to the death. What remains unanswered in a high percentage of sudden in custody restraint incidents is the question of whether prone restraint caused the death. While the incident may revolve around the subject's physiological condition of excited delirium or psychosis, frequently the pathologist will also include in the death certificate that prone restraint was contributory. When a cause of death cannot otherwise be determined, "positional, restraint or compressional asphyxia" is often suggested as playing a role in the death. The objective of this research was to prospectively analyze the outcomes of field applications of the prone restraint position used by law enforcement officers during confrontations with violent arrestees. To date only one prospective research study has been published which was design to examine the outcomes of placing arrestees in the prone position.

Hall et al.,[2,3] examined 1,255 incidents of using the prone restraint resulting from police use of force encounters for one large municipality

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in Canada over three years. They found that 40 percent of the arrestees were placed in the prone position, that all were handcuffed, about 87 percent exhibited behaviors of being under the influence of a chemical substance or mental distress, and that 20 percent had been exposed to a CEW. The researchers did not assess the extent of injury sustained by the arrestee or assess the weight applied on the back of the arrestee by officers. They did report that only one person died during the study period but was not placed in the prone position. The researchers concluded that prone positioning of arrestees was common and was not associated with a death following the police use of force. It has been theorized that the prone restraint position is inherently dangerous and contributes to a sudden in custody restraint death.[4] Reay et al.,[5,6] postulated that using the prone restraint increased the risk of asphyxia by restricting chest and abdominal movement and adversely impacts the ventilatory function.[7–9] Studying healthy volunteers, Reay et al.,[5,6] argued that during moderate exercise oxygen saturation levels decreased whereby delaying recovering time, which would further place a person at risk of asphyxia in the prone restrained position. Reay et al. also argued that weight force on the back of a combative person, including an obese person, further places the resisting person at additional risk of "compressional asphyxia," contributing to a sudden in custody death.

Using advanced research designs and physiologic monitoring, recent research has rebutted the Reay et al.,[5,6] findings.[10–18] These studies have scientifically shown no evidence that the prone restraint position poses an inherent risk of sudden death in custody or creates a deleterious position which enhances the risk of serious injury. The collective medical findings of these studies show that the prone restrain position is safer than other restraint positions, is the preferred position for control and restraint of a combative subject, and that there is no evidence that during physical activity of the control and restraint contributes to hypoxia leading to a sudden death in custody. Further, these studies do not support the contention that ventilation is significantly compromised regardless of being restrained, being restrained hogtied or placed in a prone position, with or without weight on the back, or restrained and exposed to pepper spray. Sloane et al.,[1] studied obese persons placed in the prone maximum restraint position and found no evidence of hypoxia or oxygen desaturation as a result of body position during restraint or significant differences in cardiovascular and respiratory measures.[1] Other researchers have theorized that placing a violent person in the prone position after an application of a CEW creates an elevated risk of danger.[19,20] It has been postulated that pulmonary function may be compromised from the electrical current entering the body which contributes to a sudden death in custody. Current scientific research shows that being exposed to an application of a CEW comprises only a negligible risk for difficulty in ventilation.[21–28]

Physiologic experimental studies have yielded important scientific findings which confirm that placing a combative individual in the prone position restrained does not create hypoxia, hyperventilation, hypercapnia, or produces significant physiologic respiratory compromise. These studies, however, did not replicate field arrest and restraint conditions in which police officers operate. Experimental studies using human subjects have obvious limitations and researchers must ensure the safety of the volunteers during the experiment. Conversely, police officers confront a myriad of persons who are sober, agitated, under the influence of chemical substances, and who may be mentally ill, under varying arrest circumstances and environments. Due to the limitation problems of past studies and the ongoing question about the potential hazards of the prone restraint position, this research used a prospective approach to assess field data regarding violent arrest prone restraint outcomes. This study used a prospective study design and used multiple law enforcement departments across the United States to examine the outcome of violent prone restraint incidents. Using a field prospective method counterbalances the limitations of laboratory experiments and provides a focused picture of the numerous variables which can be confronted by the officer in the field resulting in a more accurate reflection of the incident. Moreover, given the ongoing debate about the potential risk of death occurring in arrestees who are placed in the prone position, further field research examining the outcomes of violent restraint incidents is needed.

## Methods

Using a purposive sample, the study was conducted for 12 months and used a multisite prospective design, with 17 law enforcement agencies in six states participating. Incident data was collected by one designated person within the agency from January 1 through December 31, 2013. Institutional Review Board authorization was approved. Each participating agency agreed to collect the data for one year and was provided in writing with an overview of the research, the purpose of the research, and information which stipulated that anonymity of their agency, reporting officers, and the arrestee would be kept confidential. The agency head was informed of the nature of the research project, instructions on transferring arrest information to the collection instrument, and informed that they could drop out of the study at any time. The Chief or Sheriff approved participation in the project and in some agencies legal counsel also reviewed and approved participation in the research.

### I. Data collection

A one page data collection instrument was modified with permission from Hall et al.,[2,3] and designed to collect incident information. Information from the officer's arrest report/use of force report was transferred to the data collection instrument for every incident a violent arrestee was placed in the prone position. One designated agency person transferred the information from the officer's use of force report form to the data collection instrument and retained the forms until the end of the study period. The data collection instrument captured the following items:

i. Arrestee demographic information and condition of the arrestee;
ii. Nature of the call;
iii. Types of arrestee resistance;
iv. Types of force and restraints used by officers;
v. The type of force equipment used;
vi. Whether officers applied force weight on the arrestee;
vii. The number of officers on involved in the restraint;
viii. The duration the arrestee was in the prone position;
ix. The types of arrestee injuries sustained;
x. And the method and location of transport of the arrestee.

Incident data was collected when an officer encountered defensive resistance or higher. Defensive resistance is defined as an arrestee who attempted to escape the officers' grip or control by curling the arm in toward the chest, stiffening the muscles in their arm straight/rigid, pulling or twisting away, or running away from the officer.

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The resistance is not assaultive in nature and is intended to defeat an officer's attempt of physical control. More aggressive resistance and behaviors are classified as active aggression. Active aggression is defined by a subject committing a physical assault against the officer by using bodily weapons (i.e., striking the officer through punches or kicks, grabbing or wrestling with the officer). Aggravated active aggression resistance behaviors were examined and include: felonious attacks against the officer, generally using a weapon including using personal weapons (i.e., punch, kick, head-butt, and chokehold). These attacks may result in great bodily harm or the loss of human life. Multiple levels of arrestee resistance and characteristics were captured on the form as well as multiple measures of the officers' use of force. For example, thirteen different force options of control/restraint were available for agency personnel to identify per incident, plus "other potential" options. More than one force measure in each category was common in all of the incidents. Also, an arrestee could initially resist the officer through defensive resistance and then escalate to active resistance, and then to aggravated active resistance. Further, an officer may use several force measures in one incident depending on the behaviors of the person.

### II. Data analysis

The primary question posed in this research was: what is the outcome of placing a violent subject in the prone position in order to safely control and restrain the subject? The research design used quantitative methods to analysis the outcomes of the violent prone restraint incidents using descriptive assessments and chi square. Using regression analysis coefficient outcome predictive models were developed to further to assess the findings. These predictive models show common trends of the relationships between patterns of incident variables and show statistical probabilities of occurrence in similar circumstances. Probability values were established at a value of (p) 0.001.

### III. Limitations

Limitations to the study include: the data is only reflective of the information identified in the arresting officer (s) use of force report; second, the data analyzed is reflective of the information identified on the data collection instrument; third, the data reported may not reflect all violent prone restraint incidents which occurred during the 12 months at a particular agency; fourth, the data is only reflective of the accuracy of the agency personnel transferring the arrest information from the officer's arrest report to the data collection instrument; and finally, the condition of the arrestee during the incident was not confirmed but based on the perception of the responding officers and the condition/behaviors of the subject. The officers did not conduct a blood or chemical test of the person.

## Results

Of the participating agencies, 12 were municipal police departments (64%), 5 were County Sheriff departments (36%), and 6 states were represented, including: Illinois (6); Michigan (5); Kansas (3); Georgia (1); Mississippi (1); and California (1). The number of sworn officers averaged 185 per agency and the calls for service averaged 51,559 resulting in 110,173 arrests. Of these arrests, 1,085 incidents resulted in prone positioning and make up the data set. About 73 percent (n=797) of the calls for service included: a disturbance call (13%), responding to taking a mentally ill person into custody (13%),assault and battery (11%), domestic violence call (10%), serving a warrant (10%), a call of a suspicious person (8%), and performing a welfare check (8%).

### Arrestee demographics and types of resistance

About 85 percent of the subjects were male (n=920) and the average age was 37. During the confrontation the arrestee's condition appeared consistent with alcohol intoxication (26%) or other chemical substance (18%), psychological distress(22%), and/or mental distress and chemical substance (18%) accounted for 84 percent of the arrestees (n=915). An arrestee's condition was observed as either sober or undetermined by the officer in 16 percent of the incidents (n=175). Officers reported encountering arrestee defensive resistance in 71 percent of the incidents (n=775). In 25 percent of the incidents the officer encountered active resistance and in 4 percent of the incidents the individual displayed aggravated active resistance. In 44 percent of the incidents the person escalated the resistance from defensive to active resistance (n= 480). On average four officers responded to the incident (85%; n=920).

### Officer's use of force

Officers responded to a subject's resistance by using 12 different force measures beyond using verbal commands, including: empty-hand control techniques, intermediate weapons, restraints, a canine, and pointing a firearm. Officers placed an arrestee in handcuffs in 96 percent of the incidents and also used the hobble restraint strap in 23 percent when the arrestee continued to resist in the prone position. In over 95 percent of the incidents the officer used verbal commands which were frequently ignored by the subject. Following the use of verbal commands the officer used empty hand control techniques in about 89 percent of the incidents, including stuns and strikes in about 19 percent. Officers used a CEW in 20 percent of the resisting incidents and an aerosol in 15 percent. In 17 percent of the incidents, officers used the CEW in the Probe Mode and on average deployed two trigger pulls, totaling about 10 seconds. In 55 percent of the incidents the officer used two trigger pulls, 1 trigger pull in 30 percent, and 3 trigger pulls in 15 percent of the incidents. The predominate target for an application of the CEW was the back and back of the shoulder (70%), abdomen/center mass (18%), and the legs (12%). Based on the arrestee's behaviors, officers pointed their firearm at the person in 2.5 percent of the incidents but did not fire.

The use of a canine, baton, a neck restraint, and hogtying a subject was used in about 2 percent of the incidents respectively. In about 68% of the incidents an average combination of seven force measures were used and the totals will not add up to 100 percent. In response to the resistance exhibited all arrestees were placed in the prone position and about 68 percent remained in the prone restraint position. Of those arrestees who resisted in the prone position, a CEW was applied in about 17 percent. The weight of the officer was placed on the person's back to facilitate control and restraint in about 70 percent of the incidents (n=764). The duration of the arrestee being in the prone position is estimated to be from 1 to 5 minutes. The officers brought the arrestee from prone to standing in 11 percent, from prone to a side position in 6 percent, from the prone to a sitting position in 5 percent, and from the prone to a supine position in 1 percent of the incidents.

### Arrestee injury

None of the arrestees died in this study and in80 percent of the incidents the person did not sustain an injury (n=870). In 16 percent of the incidents the arrestee sustained a mild injury including: a bruise, a cut, signature marks from a CEW, hyperextension of the wrist or arm, an abrasion, and nerve/tissue injury in the wrist (n=170). In 4 percent of the incidents the individual sustained a more significant injury, including: a fracture, a severe strain, laceration, dislocation, abdominal trauma, or bite marks from a canine (n=45).

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## Method of transport and location of transport

The officers' summoned emergency medical personnel on scene in 53 percent (n=580) of the incidents and 20 percent involved the activation of the CEW. In 58 percent of the incidents the officers transported the arrestee to either the police department or to jail. In 3 percent of the incidents, officers transported the subject to the hospital for sustaining an injury and/or for a mental health evaluation. Emergency medical personnel transported the arrestee to the hospital in 39 of the incidents for the following reasons: psychological assessment (44%); chemical substance intoxication (27%); physical injury (16%); or physical injury/psychological assessment (13%). In total, 42 percent of the arrestees were transported to the hospital (n=460).

## Predictive models

Regression analysis was performed in order to assess predictive models and significant relationships of the variables which emerged from the violent arrest confrontations. (Tables 1–3) portray predictive models with which to further assess the outcomes of using prone restraint with violent arrestees. Statistical significance was measured at a probability value of (p) 0.001 (Table 1).

**Table 1** Arrestee resistance by force method, resistance type, condition of arrestee, and arrestee non-injury (N=1,085)

| Force used, arrestee condition & non-injury | Arrestee resistance type | | | |
|---|---|---|---|---|
| | % Defensive resistance | % Active resistance | % Aggravated active resistance | % Prone resistance |
| Verbal | 100 | 90 | 90 | 100 |
| Control holds | 87 | 95 | 75 | 89 |
| Stuns/strikes | 10 | 28 | 32 | 18 |
| CEW | 9 | 28 | 32 | 17 |
| Aerosol | 6 | 15 | 20 | 5 |
| Baton | --- | 2 | --- | --- |
| Canine | --- | 1 | 1 | --- |
| Point firearm | --- | --- | 2.5 | --- |
| Neck restraint | --- | --- | 2 | --- |
| Handcuffs | 96 | 100 | 100 | 100 |
| Hobble | --- | 20 | 25 | 23 |
| Weight applied | 52 | 70 | 78 | 79 |
| Alcohol intoxication | 86 | 13 | 1 | 10 |
| Psychological distress | 56 | 39 | 5 | 40 |
| Drugs | 59 | 37 | 4 | 39 |
| Psych/drugs | 58 | 39 | 3 | 41 |
| Non-injury | 84 | 81 | 80 | 80 |
| $r^2$=0.078; p=0.001 | | | | |

Officers may contact a person exhibiting alcohol intoxication only slightly more than the other groups (26%; n=285) who demonstrate resistance requiring the person to be placed in the prone position. As shown in Table 1, this group is more likely to offer defensive resistance rather than the other types of resistance. Arrestees exhibiting behaviors of psychological distress and or drug intoxication, or both, were more likely to escalate their behaviors from defensive resistance to active resistance. These confrontations involved dynamic encounters with an actively resisting arrestee, who displayed behaviors which required officers to use higher levels of force measures beyond empty-hand control techniques, including: stuns, hand/leg strikes, and CEW. This group of arrestees was twice more likely to continue to resist in the prone position than the alcohol intoxicated group, frequently requiring officers to apply the hobble restraint. A small percentage of arrestees escalated their behaviors to aggravated active aggression and officers responded with higher measures of force.

Regression analysis revealed arrestee non-injury as a significant outcome predictor as shown in Table 1.

Using arrestee non-injury as a constant predictor (80%) a combination of 7 force measures were found to be predictably related with arrestee non-injury outcomes in about 68 percent of the incidents. Arrestee non-injury remained constant, irrespective of the person's condition, 7 force measures maintained the likelihood of subject non-injury. Arrestee non-injury is significantly associated with each level of subject resistance and with the following force measures: verbal commands; use of a CEW with 2 trigger pulls; 4 or more responding officers; application of empty-hand control techniques, use of an aerosol, weight of the officer applied to the back of the prone arrestee, and the application of handcuffs and the hobble, over a period of 1 to 5 minutes. The neck restraint was used in only 2 percent of the aggravated aggression incidents and arrestees did not sustain an

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injury from its use. Arrestees were more likely to sustain any injury when they escalated their resistance above defensive resistance and as they continued to resist in the prone position during and after being restrained (Table 2).

**Table 2** Prone by weight applied, arrestee condition, and by injury (n=705)

| Variable | Subject condition % | | | |
|---|---|---|---|---|
| | Alcohol | Drugs | Psychological distress | Mental /drugs |
| Weight applied | 40 | 66 | 74 | 67 |
| Stuns/strikes | 3 | 19 | 24 | 26 |
| Control holds | 89 | 90 | 88 | 87 |
| Aerosol | 8 | 18 | 21 | 22 |
| Handcuffs | 96 | 100 | 100 | 100 |
| Hobble | 0 | 20 | 25 | 26 |
| No injury | 82 | 79 | 81 | 80 |
| Mild injury | 15 | 19 | 16 | 17 |
| Significant injury | 3 | 2 | 3 | 3 |
| Emergency medical | 5 | 34 | 32 | 38 |
| $r^2$=0.081; p=0.001 | | | | |

Controlling for weight applied on the back of the arrestee by officers, arrestee condition, and by arrestee injury, as shown in Table 2, revealed that the likelihood of sustaining an injury remained predictably low. These incidents represent 65 percent of the incidents where control holds/techniques, stuns/strikes, handcuffs and a hobble, and an aerosol was used by officers in combination with applying weight on the person's back. Arrestees resisting and demonstrating behaviors consistent with psychological distress, or a chemical substance, or both were more likely to be hobbled after being handcuffed. Individuals exhibiting behaviors resembling alcohol intoxication were not hobbled and were least likely to sustain any injury when weight was applied in the prone position by the officer and combined with other force measures. Moderate injuries were more likely with arrestees suspected to be psychologically distressed and/or under the influence of a chemical substance or both.

Injuries sustained by the arrestee were related with higher levels of resistance and the condition of the arrestee. Further, when placing the person in the prone position and applying weight on the back of the subject, and omitting the application of a CEW, the likelihood of a subject sustaining an injury remained predictably low. While using a neck restraint to control the resisting subject occurred in less than 2 percent of the incidents and restraining the subject by hogtying occurred in about 1 percent and the likelihood of sustaining an injury remained low. Although used limitedly, the outcome of deploying a canine and a baton (1%) resulted in mild injuries. Overall, the level of arrestee resistance and continued resistance while prone and being restrained is related to sustaining an injury, albeit significantly low (Table 3).

**Table 3** CEW by prone arrestee condition, weight applied, and by injury (n=225)

| Variable | Arrestee condition | | | |
|---|---|---|---|---|
| | Alcohol % | Drugs % | Psych Distress % | Psych/Drug % |
| Control holds | 100 | 88 | 90 | 91 |
| Handcuffed | 96 | 100 | 100 | 100 |
| CEW | 2 | 23 | 30 | 28 |
| Weight applied | 30 | 75 | 70 | 73 |
| Prone resistance | 16 | 49 | 51 | 49 |
| Hobbled | 0 | 22 | 25 | 28 |
| No injury | 82 | 78 | 79 | 81 |
| Mild injury | 20 | 17 | 18 | 15 |
| Significant injury | 2 | 3 | 4 | 4 |
| Emergency medical | 20 | 40 | 41 | 45 |
| Hospital by EMS | 15 | 33 | 38 | 36 |
| $r^2$=0.079 p=0.001 | | | | |

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The outcome of using a CEW, with an officer's weight placed on the back, and by arrestee condition is shown in Table 3. About 41 percent of individuals resisted after being prone and restrained. Arrestees exhibiting behaviors of drug intoxication, psychological distress, and a combination of the two, were more likely to experience a CEW exposure with 1 to 2 trigger pulls, and weight applied on their back for control and restraint. These individuals were more likely to further be restrained with a hobble. The probability of not sustaining an injury remained high even when controlling for a CEW exposure, with 1 to 2 trigger pulls, being placed prone on the ground, and weight on the back of the arrestee applied by officers. On average weight of one officer occurred in 76 percent (n=830), weight of two officers in 19 percent (n=210), and weight of three officers occurred in 5 percent of the incidents (n=58).

The use of a CEW was more commonly used to control a resisting subject who displayed characteristics of psychological distress and drug intoxication or both, and who displayed active resistance and aggravated active aggression. The officers used the Probe Mode more frequently in these incidents, with two trigger pulls, and the target location was predominately in the back of the person. About 13 percent of CEW applications impacted the chest/abdomen area in the Probe mode. Regardless of the target location of the CEW, and weight applied by an officer on the subject's back, an adverse outcome did not result. Officer applications of the CEW correspond with the behaviors of the arrestee and the instructions and officer training for deploying the CEW. When a subject continued to resist in the prone position, the application of the Probe mode was activated more frequently than the Drive Stun mode (17% v. 3%).

## Discussion

The most significant outcome finding of this research show that placing a violent resisting person in the prone position for purposes of control and restraint did not result in one death. A primary outcome predictor was that 80 percent of the arrestees did not sustain an injury during the prone restraint process and the weight of the officer was applied on the back of the subject in about 70 percent of the incidents. While in the prone position, the person continued to resist in about 41 percent of the incidents and officers hobbled the arrestee in about 20 percent of the incidents. It has been argued that at least four potential contributing components support the theory that the process of placing a combative person in the prone position and restraining the person creates a dangerous risk of death known as positional asphyxiation. It is further argued that the four components are exasperated by the condition of the person who may be under the influence of a chemical substance, experiencing a psychological distress, or both, elevating the risk of death.

The first component suggests that placing a combative person prone, in and of itself creates a dangerous risk of death to the person and has been linked to positional asphyxiation. Positional asphyxia is defined as a form of asphyxia which occurs in individuals who are found in an abnormal body position which prevents adequate gas exchange such as from upper airway obstruction or a limitation in chest wall expansion.[29,30] Commonly individuals who died were intoxicated (alcohol or depressant drug) and in an entrapped position with their head and neck hyper flexed against a hard surface or a suffocating object or between a mattress, or a person pinned under a vehicle or other heavy object and unable to remove themselves from the position, and or associated with medical disorders such as significant obesity or muscular sclerosis. Other similar cases of asphyxia deaths are referred to as mechanical asphyxia. These deaths have commonly occurred in nursing facilities or hospitals when elderly patients were placed in posy restraints, vests, or jackets, or they became entangled in bed clothing, which resulted in strangulation and asphyxiation.[31–35]

The term of positional asphyxia or restraint asphyxia was transferred from these common examples and applied as a cause of death to cases where a person died while being restrained by police officers. Proponents of this theory argued that individuals placed in the prone position and restrained with their hands behind their back and hobbled, and or hogtied (handcuffs connected to the hobble) were unable to breathe because the position caused chest wall and abdominal restriction that prevented adequate expansion of the lungs leading to asphyxia.[5–9,36] Subsequent scientific research has contradicted this theory and showed that placing a combative arrestee in the prone position and restraining the person with their hands behind their back and/or hobbled did not reveal evidence that the prone restraint position does not result in changes in ventilation sufficient to cause death.[2,3,10–17] The second isolated component posed by past researchers suggested that exposing a combative arrestee to oleoresin capsicum (OC, pepper spray) prior to being prone or while in the prone position caused the sudden death of the arrestee.[37–39] Follow-up research with human volunteers also showed that being exposed to OC prior to placement in the prone restraint position had no additional effect on the pulmonary function changes, oxygenation, or ventilation while being restrained prone.[40,41]

Third, concerns emerged about restraint deaths in custody moved to the amount of weight applied on the back of the arrestee by an officer during the process of securing the handcuffs.[5,6,42,43] Compressional or traumatic asphyxia has been applied to cases in which extreme weight force was applied to individuals such as when an automobile runs across the torso of an individual. In these cases, there is frequently evidence of chest trauma with severe limited organ damage. Subsequent laboratory research investigating the effect of weigh force on human subjects in the prone position found no evidence of hypoxia or hypoventilation when 225 pounds of weight were placed on the backs of study respondents and there were no life-threatening abnormalities.[10,13,17,44,45] Fourth, it has been suggested that exposing the arrestee to a CEW or repeated exposures to a CEW may contribute to the death of a violent and combative arrestee.[46] A CEW delivers a high voltage, low electrical impulse via either the probe or drive stun mode.

In the probe mode the device fires barbs and when contact is made in the subject the result creates neuromuscular incapacitation of the person, as well as the sensation of pain. In the drive stun mode the electrical impulse is delivered by direct contact of the device on the subject, as opposed to the barbs, and delivers a painful stimulus, with less or no neuromuscular incapacitation. Scientific research conducted on human volunteers examining the physiologic effects of CEWs found no evidence of electrocardiographic changes, cardiac or heart injuries, respiratory compromise, or significant metabolic disturbances associated with the use of a CEW.[47–54] The findings of this study are important as each of the four components and the varying conditions of the combative arrestee was observed under real time field arrest situations. These components could not be fully replicated in the laboratory due to obvious reasons. Hence, the findings of this research provide greater weight of evidence in support of the use of the prone restraint position with violent subjects. The findings showed that not one person died from being placed in the prone position and that 16 percent sustained a minor injury and that 4 percent sustained a more severe injury, all of which were associated with the arrestee escalating their resistance.

A significant outcome of this research confirms prior laboratory experiments which have determined the risks of prone restraint are minimal. Further, the infrequent arrestee injury findings in this study are consistent with retrospective studies which found that a significant majority of force incidents do not lead to a significant arrestee injury.[47,55–58] The significant outcome predictor in this study is that no arrestee died and their injuries sustained were minimal even when the arrestee vigorously fought and resisted officers' efforts of control and continued to actively resist in the prone position, and after being exposed to varying combinations of force measures, including being hobbled. Consistent with the use of force research literature in policing, use of force used by the police in this study was rare.[2,59] While the number of arrests which resulted in placing a violent subject in the prone position accounted for less than 1 percent of all of the arrests and the calls for service, the practice is common among police officers across the country and in Canada. Overall, seven arrest circumstances accounted for the majority of prone restraint incidents. Commonly, four officers responded to the confrontation on average, deployed a combination of seven force measures, beyond verbal commands, and in response to the behaviors and resistance of the subject.

Study findings demonstrate that officers applied various force measures in accordance with their training and proportionate to the types of resistance as exhibited by the arrestee and their condition. The condition of the arrestee led to higher levels of resistance and continued to vigorously resist during the restraint process, leading to the use of the hobble in 23 percent of the incidents. Officers were more likely to confront higher levels of resistance from arrestees who exhibited symptoms consistent with chemical substance influence, psychological distress or both. Even when officers used empty-hand control techniques, applied weight on the resisting subject's back, and applying an aerosol, injuries of the person were minor. Further, when officers applied a CEW with multiple applications, which averaged two, five second cycles, and weight applied on the person's back, injuries sustained by the arrestee were minimal. The major outcomes of this research align with the basic tenets of pulmonary physiology.[60–62] The study also confirms the prior published human subject laboratory research and supports what officers have been doing for many years, safely using the prone position with a violent subject for control and restraint.

The findings of this study, in concert with other studies, contradict the hypothesis that placing a violent subject in the prone position and applying weight to the back of the subject is dangerous creating a situation of "positional, restraint, compressional, mechanical, or traumatic asphyxiation." The outcomes of this research should reassure law enforcement officers that they can rely on their training, and subject control techniques, force and restraint equipment, and experience, when required to respond to a violent subject with varying force measures. As found in the medical literature positional asphyxia is a condition which does exist but applies to circumstances where a subject cannot escape a position where the head is flexed down and trapped or the person's chest is compressed causing asphyxiation due to the inability to move out of the position. In contrast, these examples of the potential for positional asphyxia differ significantly from a combative subject being restrained prone by the police.

## Conclusion

This study has shown that the police use of force is rare given the number of arrests that are made and given the number of calls for service in which officers contact citizens. The research outcomes of these violent arrests from multiple law enforcement agencies and various locations showed that placing arrestee in the prone position, who exhibited resistive and agitated behaviors, even after using numerous force measures did not result in one death, and a significant number did not sustain an injury. Study findings underscore the fact the prone restraint of a violent arrestee is not a specific risk factor for a sudden death in custody and has more to do with the pre-existing medical and mental health condition of the arrestee.[2,3,10–16,63–73] Placing violent arrestees in the prone position was shown to be a safe method of control and restraint and is the preferred position for restraining combative arrestees.[63] The study findings provide greater empirical evidence than prior laboratory research as to the safe use of the prone position as real time field confrontational variables were observed, overcoming the previous limitations associated with laboratory experiments. Officers should be confident in continuing to use prone positioning and various other force measures to control violent subjects.

However, officers are cautioned to use reasonable force as any force technique or force equipment carries a degree of risk. From an outcomes based perspective, from a risk management assessment, and from a predictive measure, police officers can be confident that when using reasonable force measures, in conjunction with the prone placement of a violent subject, do not create an adverse medical outcome. As a predictive factor, the outcomes of these violent prone incidents show that the likelihood of any injury occurring (which is low) is correlated with the degree of resistance and behaviors of the subject, the condition of the arrestee, and the continued resistance of the subject in the prone position after restraint. Further, prospective research of the outcomes of the use of restraint with violent arrestees should continue by using multiple law enforcement agencies at multiple locations, including detention facilities, throughout the country over several years. The research should be linked with emergency room treatment to examine the final treatment outcome rendered to the arrestee at the hospital.

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## Conflicts of interest

The author declares that there are no conflicts of interest.

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