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College of Social and Behavioral Sciences

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Lydia Adkins

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2017

Abstract

A Policy Evaluation: Comparing Levels of Police Injuries Associated with the Use of Less-Lethal Instruments in Law Enforcement – Conducted Energy Devices vs. Other Less-Lethal Instruments

by

Lydia Denise Adkins

MA, East Tennessee State University, 2003

BS, East Tennessee State University, 1985

Doctoral Study Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Philosophy

Public Policy and Administration

Walden University

February 2017

Abstract

Police officers continue to sustain injuries during close proximity encounters with non-compliant and combative suspects. The purpose of this quasi-experimental study was to examine whether the use of less-lethal instruments, such as conducted energy devices, oleoresin capsicum, impact batons, and hands/feet defensive tactic reduced police officer injury during confrontations with uncooperative suspects at a medium-sized police department in a southern state. Fichtelberg's democratic policing was used as the theoretical framework for this study. Data were acquired from Suspect Resistant Reports (n = 409) written by police officers over a 10-year period (1/05 – 12/14). The dependent variable was police officer injury and the categorically ranked independent variable was the less-lethal instrument. A significant association was found between officer injuries and less-lethal instruments using chi-square analysis (p <.0001). Cramer's V test for strength of association was moderately strong (.371). Odds ratios revealed that the risk of injury increased by 6.5 times when hands/feet defensive tactics or impact baton were used. However, the risk of injury decreased by 10 times if conducted energy devices were used. The positive social change implications of this study include recommendations to law enforcement executives to consider policies and procedures that reinforce the use of CEDs over other less-lethal options, especially the impact baton, which was found to be rarely deployed and risky in terms of officer injury when used. Addressing these policies my result in reductions in officer injuries and improved public safety for the community overall.

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Dedication

I would like to dedicate this dissertation to my daughter, Riley who inspires me to be a better person and my husband, Todd who constantly reminds me that I can do anything. They have supported me throughout this journey with constant motivation and plenty of patience and understanding. It is with their support and love that I am able to achieve my goals and dreams, and for that I am eternally grateful.

I would also like to dedicate this dissertation to the memory of my mother, Joyce Church. She was and remains a source of love and strength for me today.

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I would like to take this opportunity to express my gratitude to the Chair of my dissertation, Dr. Olivia Yu, who has helped me to think on a higher level, has encouraged me to develop my research to the fullest potential and challenged me to strive to be an academic scholar. I also extend appreciation to Dr. Mark Stallo, who is my Committee Member and also a fellow law enforcement officer. I would like to thank Dr. Tanya Settles, the University Research Reviewer for keeping me within the strict academic tracks of a true scholar.

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Chapter 1: Introduction to the Study

Introduction

Police officers continue to sustain injuries when addressing noncompliant and combative suspects, regardless of the overarching opinion that police officers should be safe while executing their sworn duties (Herbert, 1998). Less than 2% of police and citizen encounters result in the police using physical force (MacDonald, Kaminski & Smith, 2015). Most injuries received by officers are not serious, but they have a strong impact on the officer and her or his department (Herbert, 1998). In response to the fact that police officers are still getting injured during law enforcement encounters, police departments are increasingly adopting less-lethal instruments as a means of reducing such injuries (MacDonald, Kaminski & Smith, 2009).

Public concern for health and safety, human rights, and the use of less-lethal technology has had a positive influence on police agencies in the adoption of use-of-force policies (Amnesty International, 2004). Officers have been trained to use a variety of physical and weapons-based tactics to manage violent or potentially violent situations, for example, when managing combative citizens resisting arrest (Paoline III, Terrill, & Ingram, 2012).

Managing the use of force is one of the most important, yet challenging, tasks for any police department. Law enforcement has evolved since the mid-19th century, when wooden clubs were the predominant choice of weapon during violent encounters (Bulman, 2011). A transition away from wooden clubs to more sophisticated less-lethal

instruments—such as oleoresin capsicum (OC spray), impact baton and CEDs has been instrumental in transforming the use of force by police (Bullman, 2011).

The changes in use of force trends can be seen through police departments adopting various, innovative less-lethal instruments in anticipation of reducing injuries to both police officers and citizens (Oliva, Morgan & Compton, 2010; Kaminski, Rojek, Alpert & Mathis, 2007). The progression of law enforcement to reduce injury has spurred the adoption of less-lethal technologies (Jenkinson, Neeson. & Bleetman, 2006). Currently more than 11,000 law enforcement agencies equip their officers with CEDs to control resistant and combative suspects (MacDonald et al., 2015).

In this study, a quasi-experimental research design was used to examine police officer injuries (dependent variable) by comparing less-lethal instruments (independent variable). Less-lethal instruments were operationalized as a categorical variable with the following instruments ranked according to the proximity of the officer to the suspect: hands/feet defensive tactics, impact baton, OC spray, CED. Cross-tabulation, chi-square test, and odds ratio were used to statistically evaluate the variables.

This study examined archived reported police officer injuries when less-lethal instruments were used. Analysis of the empirical evidence found that a medium-sized law enforcement agency's adoption of CEDs achieved the goal of reducing police officer injuries. The results of the quantitative analysis will be discussed in Chapter 4 and Chapter 5 will discuss the interpretation of the findings as well as the limitations of this study. Recommendations and implications for positive social change spurred from this study is further discussed in Chapter 5.

Background

The need for less-lethal instruments has emerged from different directions, including police and citizen encounters in which police officers used deadly force because less-lethal instruments had not been issued to them (Worley & Worley, 2011). The growth of OC spray during the 1990s led to an even larger emergence of CEDs in the law enforcement community beginning in the early 2000s. CEDs, unlike the officer's sidearm, is not intended to cause serious injuries or irreversible harm to the suspect, but rather safely and temporarily incapacitate resistive suspects (Kaminski, 2009).

Similar to the controversies that emerged with the widespread use of OC spray, police officers using CEDs have experienced a rise in liability issues. To address those issues, the Police Executive Research Forum (PERF) created principles for the purpose of guiding police officer's use of CEDs in order to avoid crises (Frasier, 2005). The PERF stated that each and every deployment of a CED should be followed by the completion of a use-of-force report by the officer using the device (Kaminski, 2009). Other guidelines considered limiting the use of CEDs on (a) individuals outside the age range of 14-64, (b) women who are pregnant, and (c) individuals observed to be mentally incapacitated.

Further consideration should be given to restricting the use of the CED if the individual would suffer serious bodily harm or death from a resulting fall they would sustain when the CED is deployed (Worley & Worley, 2011) —typically the most serious injuries (Crow & Adrion, 2011). The PERF also advised against using CEDs in situations where a suspect has previously been sprayed with OC, especially by another

agency, and the OC composition is unknown, since all agencies do not issue a standard OC compound (Kaminski, 2009).

As law enforcement agencies continue to train officers in the use of CEDs, they must also deal with ongoing public controversy (White & Ready, 2009), especially those in which CEDs have injured or killed suspects. These challenges could lead to charges of excessive use of force, inadequate policies, or a breakdown in training. This study is warranted because it presents evidence on the use of less-lethal instruments and the reduction of police officer injuries and provides information for policy initiatives and change regarding use of force.

CEDs

CEDs are among several intermediate levels of force police officers have available to them when faced with resistant and combative suspects, however CEDs have emerged as the most popular (Bozeman, Hauda, Heck, Graham, Martin, & Winslow, 2008). The X26 model is most preferred by law enforcement agencies. It has an effective range of 21–25 feet (Adams & Jennison, 2007; Taser International, 2009).

CEDs, widely known as a TASER (Thomas A. Swift Electrical Rifle) was first developed by Jack Cover, an aerospace engineer, during the 1960s (Frasier, 2005). CEDs have been further developed by Taser International, a corporation that has become the leader in CED development for law enforcement agencies (Taser International, 2008). Tasers have been around for approximately 20 years, when they were viewed as unreliable for law enforcement because their effective range was roughly 6 feet (Klinger, 2008). This distance placed the officer and suspect at a very close proximity, risking

injury to the officer. Several electrically charged devices have been patented, with the M26 Taser emerging as the first reliable model for law enforcement, and evolving into a more advanced X26 model, which has become the most widely adopted model by law enforcement.

The X26 functions in two modes. The first mode fires two small electrode darts, propelled by compressed nitrogen charges that stay connected to the device by conductive wires (Taser International, 2009). The electrodes are pointed and barbed to penetrate clothing and to prevent the removal once deployed. The cartridges have an effective range of 21–25 feet and emit an electrical current for approximately 5 seconds (Vilke & Chan, 2007; Taser International, 2008). The electrode barbs must be replaced after each use.

The second mode is called the drive stun mode where the barbs are not deployed. Instead, the taser is held against the suspect. Electro muscular disruption causes pain which typically results in compliance (Taser International, 2006). This mode requires the officer to be in close proximity to the suspect; thus, she or he could be injured. Drive stun is a feature of most models adopted by police, including the X26.

CEDs are designed to gain compliance from combative suspects. This is accomplished through initiating temporary pain through less-lethal force, while allowing the officer to maintain a safe distance and affect the arrest safely (Miller, 2010). The adoption of less-lethal technologies such as the CED gives law enforcement an alternative when lethal force is not necessary or justified (Bureau of Justice Statistics, 2014).

This study compared the use of a CED to three other less-lethal instruments: OC spray, impact baton, and hands/feet defensive tactics. According to the results, CEDs resulted in fewer reported injuries to police officers.

Problem Statement

Most law enforcement agencies develop training curriculum instructing police officers in the proper and lawful application of force through various physical techniques and approved weapon-based instruments. Training and instruction are developed by police agencies based on sound judgment for what is safest and the most effective use-of-force policies in the communities (Taylor et al., 2009). These policies provide police officers with the knowledge and skills necessary to make arrests and address citizens who are non-compliant and combative.

As police officers continue to respond to public needs and calls to service, they also continue to be injured during suspect encounters (Taylor & Woods, 2010). Many tasks officers perform require them to physically subdue, restrain, or handcuff combative suspects. Research shows that the proximity of officer and suspect contributes to injuries for both officer and suspect (Blake, 2014). A resolution to this problem is an intermediate, less-lethal instrument that incapacitates the suspect and thus prevents injury to the officer and suspect (Gervais, Baudin, Cruikshank, & Dahlstedt, 1998).

Most injuries police officers sustain are not serious or life threatening; however, they have an impact on the police agency in possible loss of manpower, medical costs and workers compensation (Paoline, Terrill, &Ingram, 2012). Police officers are further impacted as they deal psychologically following injuries from a loss of control during the

encounter and loss of confidence in their abilities to perform their job (Ashley & Golles, 2000).

An estimated 2% of police and civilian contacts result in police use of force and police officers consistently receive injuries as they struggle with combative suspects and most of those injuries happen when police officers use defensive tactics. In 2012, according to nationwide statistics collected by the FBI, 52,901 police officers were assaulted of which 27.7% suffered injuries (FBI, 2012). The number of officers (on duty) assaulted during 2012 dropped slightly to 49,851.

The FBI found that approximately 80% of the officers assaulted and injured were attacked by suspects using their hands and feet, punching and kicking the officer, and yet police injuries based on distance to the suspect has not been properly evaluated through scientific research. The injuries to officer's resulting from using hands and feet defensive tactics greatly outnumbered injuries received through other methods of contact, where 4.5% were attacked by suspects using firearms, 1.8% used knives against the officer and 14% were attacked by suspects using other dangerous instruments (i.e. hammers, clubs, and hatchets). Given the predominant injuries to officers when suspects use their hands and feet, close proximity to a suspect is more likely to lead to injuries (MacDonald et al., 1009; Terrill & Paoline, 2012).

Very few encounters necessitate deadly force. Most injuries to officers occur when the officer deploys hands and feet defensive tactics (punches/hand strikes, kicking), wrestling and body defensive techniques (Alpert & Dunham, 2004; Smith et al., 2010). Approximately 70% of police officer injuries occur when these tactics are used.

However, when defensive tactics are ineffective and lethal force is not justified, less-lethal instruments become an intermediate level of force (Paoline et al., 2012).

A primary goal driving use-of-force policies is for the officer to use the least amount of force necessary to control the individual, with no or minimal injuries to all parties involved (Alpert & Dunham, 2014; Hough & Tatum, 2010). The introduction of CEDs into the law enforcement continuum of force has been championed as a step toward apprehending suspects while reducing injuries to officers (Alpert & Dunham, 2014; Bozeman et al., 2008). To address this type of injury, more than 11,000 law enforcement agencies in the U.S. have incorporated CEDs as a less-lethal use-of-force instrument to create much needed distance between the police officer and combative suspects so the officer can safely gain physical control of the suspect (Bulman, 2011). The use of CEDs provides for the greatest amount of distance between the officer and suspect, while providing a less-lethal, incapacitating temporary electrical shock to the suspect.

Using weak research designs, police agencies have come under much scrutiny and criticism for the use of CEDs to help facilitate the reduction of police officer injuries (Paoline III, Terrill, & Ingram, 2012). The criticism is a result of potentially biased police-sponsored research projects examining CED use prior to and following the adoption of CEDs (MacDonald et al., 2015; Paoline III et al., 2012). Other factors contributing to sketchy results are inefficiencies associated with the data collection, and missing or incomplete data.

CEDs are viewed by law enforcement as an advanced technology tool that provides a means for more effective control, with fewer injuries, during custodial matters (Ferdik et al., 2014). The effect of CED use on reducing officer injuries in comparison to other less-lethal instruments has been unclear, as existing studies have yielded inconsistent results (Terrill & Paoline III, 2011). The lack of clarity has called for more evaluation studies based on systematically collected evidence and data analysis regarding the use of CEDs. This study has addressed the need for clarity by using a quasi-experimental approach finding that as police deploy CEDs, the reported police officer injuries are reduced.

Purpose of the Study

The purpose of this quasi-experimental study was to examine whether the use of less-lethal instruments, such as conducted energy devices, oleoresin capsicum, impact batons, and hands/feet defensive tactics reduced injuries to officer at a medium-sized police department in a southern state. A comprehensive literature review along with empirical data collected from the Johnson City Police Department determined that the use of CEDs reduced police officer injuries and has contributed to the policy goal of reducing officer injuries. The policy analysis further evaluated the predicted outcomes through a stated hypothesis and quantitative approach. The central goal of this policy analysis was to provide empirical evidence reflecting the effectiveness of the policy as well as providing knowledge, data, and facts for future policy monitoring, evaluating and implementation.

This evaluation focused on a medium-sized police department. In the past, researchers focusing on police officer injuries have used data from large metropolitan police departments, such as Miami-Dade Police Department in South Florida and Baltimore County in Maryland (Smith et al., 2007). Law enforcement use of force has come under controversy and public scrutiny following decisions made by officers' use-of-force (Paoline et al., 2012).

Bulman (2011) studied less-lethal weapons and tactics used by police officers and found that injury reduction for police officers were more likely when police departments provided CEDs and OC spray to the officers. The particular distance between the officer and suspect was not calculated or studied, however the physical struggles were minimized through using CEDs and OC spray. Bulman (2011) also found that when police officers used physical force (hands and feet defensive tactics), the likelihood of officer injury increased by 25%.

A large national multi-agency study was conducted examining CED use compared to hands and weapon-based tactics in relation to police officer injuries (Paoline, Terrill, & Ingram, 2012). This study found when CEDs were used that fewer police officers were injured than when police officers engaged suspects using hands and other weapon-based tactics. This study provided further detail on the topic of police injury by closer examining the notion that the likelihood of police officer injuries are significantly associated to the distance between the officer and suspect.

This study provided scientific evidence regarding police use of less-lethal instruments during police and citizen encounters, especially providing insight into how

police officer injuries are reduced using less-lethal instruments. The data gathered for this study analyzed officer injuries (dependent variable) comparing the use of CEDs to other less-lethal instruments (independent variable): hands/feet defensive tactics, impact baton, OC spray and CED and finding that the use of CEDs resulted in fewer police officer injuries than other less-lethal instruments. The analysis was further expanded with the incorporation of the impact baton into the category of hands/feet defensive tactics in consideration of statistical assumptions yielding similar results as the initial analysis of four categories. The results of this study are now a source of information for communities as well as law enforcement policymakers concerned with police officer injuries.

Theoretical Foundation: Democratic Policing

In the United States, police officers are trained through police in-services as well as during field training to use only the force necessary to gain control of combative suspects. Adherence to policy and commitment to procedures and rule of law is an essential foundation to policing in a democratic society. Police are a fundamental force in a democratic society and while performing law enforcement duties; they are obligated to perceive their responsibilities as the protection of human rights (Manning, Elmer, & Brooks, 2014).

With respect to using only the necessary force needed to apprehend combative suspects and the police's highest priority of admiration for and the fortification of life, this study has assessed how this goal of democratic policing is better achieved by the use of some less-lethal tools over others. Democratic policing is defined by police accountability and transparency (Fichtelberg, 2008) and is supported by the principle that

building trust with the community is the foundation of more effective policing (Manning, 2011). It is through democratic policing that law enforcement officers exemplify human rights in the application of force through using less-lethal instruments. The adoption of less-lethal instruments enables law enforcement to embrace democratic policing as a process and not an outcome.

Police are a civil force of the national or a local government; they are emergency responders in most critical situations and have the duty of keeping order, maintaining peace and may use force to achieve these objectives in certain situations. Police attitudes and training have evolved over time regarding the task of controlling combative suspects. The force police use must be proportionate to the threat and executed in the most humane manner possible in an effort to maintain public trust and confidence. Advancements in technology have increased the ability of law enforcement to achieve this ideal with instruments aimed at incapacitating with no serious injuries (United Nations, 1997).

Police use of force has come under great public scrutiny with much attention given to the militarizing of law enforcement through equipment, vehicles, tools and technology (Singal, 2014). It is imperative for police operating in a free and democratic society to distinguish themselves from militarized tactics; strategies and defensive instruments used by the military given the two have completely different missions. The tools and technology adopted from the military differ substantially from the traditional use-of-force instruments police have normally used. Soldiers are trained for combat followed by apprehension and then peacekeeping. Police focus on a contrast of events as they strive initially for peace then apprehension and as a last resort they use force (Marx,

2001). During operations, the military accept certain causalities and at no time does law enforcement operate with an acceptance of casualty or loss of life.

The ability of police to control a combative suspect with minimum possibility of causing death or injury is enhanced with the use of various less-lethal instruments, and some of them afford police more distance from the suspect than others. Police officers draw upon many components when faced with a combative and resistant suspect. Technology has greatly advanced police officers' ability to resolve physical encounters positively, providing alternatives to deadly force and other instruments that cause serious physical harm.

It is widely accepted that police officers should expect to remain safe and free from injuries while executing their duties as law enforcers (Singal, 2014). Proximity-based police officer injury precisely denotes why and how police officers continue to receive injuries when less-lethal instruments are used. The four less-lethal policing instruments this research analyzed provided a scaled measure distinguished by the proximity they allow an officer from a combative party and therefore statistically test the role of proximity in officer injuries.

Democratic policing provided the framework for this study through focusing on the distance created by less-lethal instruments. Attention to using less-lethal force and creating the most distance between the officer and suspect, this study found that fewer police officer injuries were reported, while attention to the well-being of the suspect was considered as police officers used necessary force. The likelihood of police officer injuries, similar to suspect injures is significantly associated with the distance between

the officer and the combative suspect. Democratic policing is a guiding concept as police officers address combative suspects in accordance with departmental policy using the least amount of force necessary (Marx, 2001).

This study not only addressed this notion in the research question, but measured police officer injury by expanding the less-lethal instruments into four measurable categories within the independent variable. The concept of proximity was established in the literature on police injuries emerging from the results of this research. Many studies addressing police officer injuries have closely examined less-lethal instruments and police officer injury, but have not categorized less-lethal instruments as this study did.

Significance of the Study

More and more police agencies have adopted the CED as a less-lethal instrument. The CED is not the only kind of less-lethal instrument available to police. The contribution of this study was realized through its unique approach in comparing the effect of CEDs on police officer injuries with other less-lethal instruments and what resulted in finding the use of CEDs was more effective in reducing injuries than the other studied less-lethal instruments.

As police administrators struggle to meet the challenges involved in managing police use of force, studies are needed to educate and inform through empirical-based findings and conclusions to positively influence law enforcement policies and procedures. A comprehensive analysis and review of data on CED use and police injuries has informed and answered the research question as well as influenced future

policymaking decisions for law enforcement administrators and provided insight for changes to training (Thomas et al., 2010); White & Ready, 2007).

No previous studies have examined the use of less-lethal instruments categorized by the distance between the officer and suspect when the instrument is deployed. The basic goal of using less-lethal instruments is for police to apprehend combative suspects without receiving injury as well as not injuring the suspect. The nature of law enforcement is to protect citizens and not to inflict injury, while executing lawful duties and respecting the rights of the suspect (Marx, 2001). This study presented unparalleled research examining police injury and less-lethal instruments from the perspective of democratic policing. The research question and hypothesis were developed on this notion and were tested with data from a medium-sized police department.

Research Question and Hypotheses

This study investigated the question if the use of CEDs has resulted in fewer officer injuries than the use of other less-lethal instruments when handling un-cooperative suspects. Based on a review of the literature, this study tested the hypothesis regarding the use of CEDs and other less-lethal instruments as well as officer injuries during physical counters between officers and resistant suspects. Therefore, the following null hypothesis was tested:

H_0: There will be no significant difference in reported police officer injuries when police use conducted energy devices on combative suspects compared to when police use other less-lethal instruments.

H_a: There will be significantly fewer reported police officer injuries when police use conducted energy devices on combative suspects compared to when police use other less-lethal instruments.

Research literature has primarily suggested that police officer injuries are substantially reduced after the implementation of CEDs (Alpert & Dunham, 2010; Paoline et al., 2012; Bulman, 2011). Similar to previous studies, the statistical analysis supported the rejection of the null hypothesis and found there was significantly less reported police officer injuries when police used CEDs on combative suspects than when police used other less-lethal instruments.

Limitations

Considering the professional trends in law enforcement, police documentation of incidents, arrests and reports have come a long way in the process of archiving police records in law enforcement. When using secondary data, there is always the inherit risk of problems associated with the data being inaccurately documented and maintained.

Observation in a law enforcement setting where police officers are interacting with citizens pose unique challenges. Research observation may create a situation where officers do not respond as they would when not being observed. Sousa, Ready and Ault (2010) found that survey research and citizen complaints are likely to show more police reliance on physical force than observational studies reveal. This study was also limited to data collection and analysis only to police officer injuries and not injuries to the suspect involved in the police and citizen encounter.

The data collected from one medium-sized law enforcement agency as with this study may be inappropriate to draw conclusions and generalizations to other law enforcement agencies, especially since states are not required to maintain a standardized database for collecting and maintaining police use-of-force data (Alpert & MacDonald, 2010). Suspect Resistant Reports occurring between January 2005 and December 2014 documenting the use of hands/feet defensive tactics, impact baton, OC spray or CED were included in the analysis. Reports documenting deadly force, K-9 deployment, use of police vehicle as force or the reported deployment of multiple less-lethal instruments were excluded from the analysis. Each Suspect Resistant Report was carefully reviewed to ensure no duplications were included.

Assumptions

When using a quantitative approach in a research study, there are certain underlying assumptions that should be clearly identified and stated to ensure the researcher is adhering to important paradigms and protocols in alignment with quantitative analyses (Hathaway, 1995). The researcher was objective and independent from what was being studied and in no way contributed their own values or biases. The research was value-free (Cohen & Crabtree, 2006) and based on deductive forms of logic and theories. The researcher applied numerical codes to observations for the purpose of yielding statistical analysis. Strict methodological protocols were followed, ensuring research was void of subjective bias and objectivity was achieved.

Quantitative research assumes that reality can be studied objectively through a deductive process based on a set of defined definitions in the treatment of data throughout

this scientific inquiry. Quantitative research provides for the testing of hypotheses in a cause and effect manner where the goal is to develop generalizations that contribute to the theory guiding the study (McHugh, 2013). Additionally, assumptions for the methodological approach using chi-square test holds that random sampling is not required as long as the sample is not biased. Mutually exclusive row and column variable categories that include all samples are expected when using chi-square to analyze data. These assumptions have allowed the researcher to predict and explain police officer injuries and less-lethal instruments.

Summary

Injuries to police officers continue to be a problem to public health and safety. As the number of police officer's injured during police and suspect encounters increase, law enforcement agencies have equipped their officers with a variety of less-lethal instruments. The CED has been adopted by well over 11,000 law enforcement agencies across the U.S. in an effort to reduce injuries to police officers.

The research from this study examined secondary data extracted from Suspect Resistant Reports from the Johnson City Police Department, a medium-sized police department. This study answered the question, has CEDs, when used in suspect and police encounters result in fewer officer injuries than when other less-lethal instruments are used? Police use of force is a social issue greatly impacting the community's perception of public servants. Results from this study presented statistical evidence to guide and assist policymakers and police administrators create effective policies with widespread implications positively impacting social change. This study has contributed to

the literature already on the topic of police officer injuries and police use of force resulting in more effective and less-lethal means of diffusing physical confrontations.

Chapter 2: Literature Review

Introduction

In the review of the literature, I present the historical background on injuries to police officers and less-lethal instruments, including the CED, oleoresin capsicum, impact baton, as well as hands and feet defensive tactics used by police officers addressing resistant and combative individuals. This review examined research involving police use of force, in particular, less-lethal force, and the injuries officers sustained during those encounters.

The literature reviewed for this study was gathered through scientifically respected search sites. The FBI library located at the FBI Academy was used for literature research as well as the National Institute of Justice for government research studies, policies and procedures. The most relevant and current articles were selected for this literature review.

Democratic policing is the framework for this study and was essential in guiding this study to review literature, analyze data and answer the research question based on the use of less-lethal instruments and police officer injury. What is learned through democratic policing has contributed to answering if the use of CEDs has resulted in fewer officer injuries than the use of other less-lethal instruments when handling un-cooperative suspects. Understanding the use of less-lethal technology is a critical component in realizing the need and subsequent emergence of less-lethal technology. Research conceptualizing the injuries police officers have experienced must be examined to better understand the contributions less-lethal technology has provided to reducing police

officer injuries. Medical health research has been directed at law enforcement's use of less-lethal technology and has played a significant role influencing the choices to adopt certain use-of-force technology.

Studying factors that lead to police officer injuries during violent police and citizen encounters continues to be central to law enforcement research (Smith, Kaminski, Rojek, Alpert & Mathis, 2007). The National Institute of Justice has supported many studies on the safety and effectiveness of CEDs, just as it did for oleoresin capsicum during the 1990s (Alpert et al., 2011). Researchers studying CEDs, OC spray, impact baton and defensive tactics have focused on those instruments' incapacitating properties (Paoline et al., 2012). A number of studies have examined the injuries to suspects as well as officers caused by CEDs and less-lethal instruments (White & Ready, 2008).

Law enforcement research on use of force has focused primarily on excessive force dating back to 1991 when an African-American, Rodney King, was beaten with impact batons by police officers of the Los Angeles Police Department. This incident was videotaped and spurred great public interest with police use of force (Kaminski & Sorensen, 1995). Considerable research has also been conducted on in the line of duty deaths among police officers. Police officer injuries have received far less attention and are on a much greater scale (Smith & Petrocelli, 2002).

The FBI collected data from 11,944 law enforcement agencies with a total of 545,651 officers. During 2011, law enforcement agencies reported that 54,774 police officers received injuries while performing their duties at a rate of 10.2 per 100 sworn officers. In 2011, 72 law enforcement officers were killed in the line of duty (this number

excludes accidental deaths including motor vehicle accidents). In spite of the disparity, research continues to neglect the growing social issue of police injuries.

Kaminski and Sorsenson (1995) studied 1,550 less-lethal assaults on police officers in Baltimore County, Maryland, between 1984 and 1986. Examining use of force reports for the purpose of identifying predicting factors associated with police officer injuries. The variables used in this study were categorized into one of three categories, (a), officer and assailant attributes, (b), situational characteristics, and (c), environmental characteristics. Police officer injury is the (binary) dependent variable coded accordingly. Multivariate logistic regression was used to treat the variables and predict the likelihood of police officer injuries.

Understandably, given the dates this study was conducted, less-lethal instruments were not a component factored into police injuries. Kaminski and Sorsenson (1995) found that police officers with less than a 4-year college degree (officer attributes) were more likely to be injured, possibly attributed to better communication along with critical thinking skills acquired through higher education. Additionally, it was found that the precinct, race of the assailant, height, and years of service with the department were all significant variables predicting officer injuries. Suspect encounters where the suspect was under the influence of narcotics or intoxicated increased the percentage of officer injuries as well.

Kaminski and Sorensen's study, like many other studies, attempted to identify predictors of officer injury by examining the variables through a quantitative analysis for the purpose of predicting injuries to police officers during violent encounters between

police and citizens (Kaminski & Sorensen, 1995). Contrary to some ideology that female police officers are at greater risks of injury when involved in physical suspect encounters, the study found that gender was not a significant predictor of police officer injury. Police officer injury was identified as the (binary-coded) dependent variable, where multivariate logistic regression was used to analyze more than two dozen independent variables included within the three major categories listed previously. Kaminski and Sorensen did not incorporate the BCPD force continuum or the level of force used during the encounters, leaving avenues for future research pertaining to use of force, officer injury and the force continuum.

White and Ready (2010) used three different but related measures of effective/ineffectiveness as the dependent variables. The first two variables measured ineffectiveness of the CED and were based on suspect resistance, specifically if the resistance stopped resisting following the deployment of the CED and how much time was required to achieve suspect incapacitation. The third variable measured effectiveness by analyzing police officer satisfaction (whether or not the officer felt the CED effectively achieved incapacitation). This data came under scrutiny since the specific times documented by the police officers engaged in the incident may not have an accurate accountability of exactly how many seconds/minutes it took to incapacitate a suspect.

For this reason, White and Ready (2010) chose to focus on dichotomous measures to analyze suspect resistance. The review of the literature found the police officer's perspective of effectiveness for the CED provided knowledge of the CED used on resistant suspects. This study also found the CED was effective in creating distance for

the police officer in adequately incapacitating the suspect. Additionally, the darts from the CED struck the suspect at the intended area successfully incapacitating suspects welding both firearms and knives.

According to the Federal Bureau of Investigation (2011), during 2013 a total of 49,851 law enforcement officers were victims of an on-duty assault. During 2012, even more officers were assaulted with a total of 52,901. Approximately 1 of 10 police officers received injuries more than 29% of the time when engaged in citizen and police encounters, supporting the need for less-lethal instruments to subdue combative suspects and to create much needed distance between officers and suspects when encounters become physical.

The continued support of CEDs for law enforcement use has been exhibited in the number of CEDs adopted, with approximately 260,000 in operation throughout U.S. law enforcement agencies (Terrill & Paoline III, 2012). Therefore, it has been established that CED use by law enforcement has become a common and popular device comprising the law enforcement less-lethal arsenal.

When police officers employ physical force, the possibility of injuries to everyone involved escalates and understanding the impact of less-lethal instruments used during these encounters can be realized through documented scientific research (Engel, 2008; Kaminski, 2009). A variety of research has been conducted on the use of CEDs by police agencies, with injury reduction as the primary goal through preventing physical struggles between citizens and officers.

New and innovative technology related to use-of-force instruments has spurred studies comparing CEDs and other less-lethal instruments. The comparison of CED use to other less-lethal instruments such as defensive tactics (physically holding/restraining, kicks or punches), OC spray and the impact baton grew as CED popularity began to emerge in the 2000s (Alpert et al., 2011; Bulman, 2010; Taylor, Woods, Kubu, Koper, Tegeler, Cheney, Martinez, Cronin & Kappelman, 2009).

Smith, Kaminski, Alpert, Fridell, MacDonald, and Kubu (2010) conducted a large multi-agency evaluation of police departments concerned primarily with injuries to police officers and suspects sustained during police encounters. The researchers discovered through conducting this study that police departments throughout the United States employ various methods of record keeping, and unfortunately was lacking in uniformity. Many agencies that were surveyed were unable to provide data because it was not collected or was not exportable or useable for research purposes.

The three following police agencies; Miami-Dade Police (MPD) in South Florida, Richland County Sheriff's Department (RCSD) in South Carolina and the Seattle Police Department (SPD) in Washington were closely examined through accurately recording observable incidents where police deployed force through various less-lethal instruments. Incidents of force at these agencies were the focus of this in-depth exploratory study representative of different states as well as department sizes (Smith, Kaminski, Alpert, Fridell, MacDonald, & Kubu, 2010).

Serving the rural areas of Richland County, South Carolina, the RCSD has approximately 475 sworn officers equipped with a .40 caliber handgun (Glock

manufactured), metal collapsible impact baton, OC spray and approximately 60% of the patrol units were issued the model X26 CED at the time of data collection. The deputies at RCSC followed a use-of-force continuum framing their use of force policy (Smith et al., 2010).

Richland County provided 467 usable use-of-force reports ranging from January 2005 through July 2006 with officer injury as the dependent binary variable coded 0 for no injuries and 1 for when the officer received injuries (Smith et al., 2010). The independent variables at Richland were measures of force the officer used, suspect resistance, and the number of officers, witnesses, and resistant suspects on the scene at the time of the incident. Continuing to empirically code the independent variables ranking the force and suspect resistance levels. The number of officers, witnesses, and suspects was also assigned a numerical value.

Using logistic regression models, for the Richland police officer injuries and suspect injuries, the findings from the analysis showed that police officers employing soft empty hand controls (defensive tactics) received injuries most often at 59% of all force encounters. During these encounters utilizing soft empty hands, the odds of officer injury increased by approximately 160%. When police officers used soft empty hands, they are physically wrestling and subduing individuals, with no means of creating distance in order to control a suspect or affect an arrest.

The analysis found that OC used by officers reduced the odds of injury happening to a suspect by 70% consistent largely with most findings associated with OC use. Reducing the odds of injury even more was the act of pointing a firearm at a suspect,

which reduced injury by 80%. However, the threat of deadly force is not always warranted or supported by the force continuum (Smith et al., 2010).

The use of CEDs at Richland County was statistically insignificant and did not increase nor decrease the odds of injury to suspects or police officers. Consideration should be given that not all RCSD deputies were trained and issued the CED during the data collection period, which may have impacted the use of the instrument. However, this finding showed that not every police agency's experience with CEDs to be consistent.

Miami-Dade Police Department is the largest police department in the Southern United States employing approximately 3,000 sworn police officers (Smith et al., 2010). MDPD serves in excess of one million people in an area approximately 1,840 square miles with one of the most diversified populations in the Southeast. MDPD is both a nationally and state accredited law enforcement agency recording and maintaining comprehensive records and statistics regarding MDPD officer's use of force.

Miami-Dade police officers are trained on and carry semi-automatic handguns, impact batons, but have never been issued OC spray. MDPD adopted the M-26 Taser in 2003 (Taser International product) and have since transitioned to the more popular model, the X-26. However only 70% of Miami-Dade's officers were trained and actively carried the CED during the period data were collected.

Miami-Dade provided 1,178 use-of-force incident reports dating from January 2002 to May 2006 and since MDPD uses a rigorous reporting structure, the analysis for MDPD officer and suspect injuries was simplified by extracting only reports involving a single officer and a single suspect with a final sample size of $n = 782$. The summary

statistics showed that MDPD officers were substantially less likely to sustain injuries with only 16.6% of the officers injuries compared to 56.3% of suspects receiving injuries.

The researchers accounted for the larger sample size and modeled the MDPD similarly to RCSD using binary logistic regression, finding consistent with RCSD's use of soft empty hands, where MDPD officers doubled the odds of officer injury when employing soft hand tactics through compliance holds, hands and feet techniques (odds ratio = 2.33, p = .02). MDPD doubled the odds of police officer injuries when applying hard hands tactics through the use of impact batons (odds ratio = 2.62, p = .012), and well exceeding soft hand tactics (Smith et al., 2010). Inconsistent with the findings of the RCSD model and taking into account that MDPD had not fully deployed CEDs to the police force, the use of CEDs was associated with reducing the odds of police officer injury by 68% (odds ratio = 0.32, p = .040).

The Seattle Police Department has approximately 1,200 sworn police officers and is a nationally accredited law enforcement agency serving an estimated population of 582,174 (Smith et al., 2010). SPD is a progressive police department issuing less-lethal instruments, including OC spray, impact batons, and shotgun beanbags. SPD adopted the M26 taser in 2000 and transitioned to the X26 model in 2005. At the time of data collection, over half of the sworn officers were trained and carrying the X26 model on duty.

The data for the Seattle study consisted of 676 use of force incident reports with the date of collection beginning December 1, 2005 through October 7, 2006. Consistent with literature on police interactions with non-compliant suspects, the officers at the SPD

used physical force (hands/feet defensive tactics) in more than 76% of recorded incidents (Smith et al., 2010; Smith et al., 2007). Taser use made up 36% of the force reported on use of force reports, followed by OC spray with only 8% deployment. SPD deployed impact batons so few times during the data collection period (18 baton uses), the impact baton was not included in the data analysis (Smith et al., 2010).

Similar to RCSD and MDPD analyses, separate binary logistic regression models for officer and suspect injuries were conducted. Findings were consistent with MDPD in that physical encounters between police officers and suspects increased the odds of both suspect and officer injuries, but the results were not significant at .10 level ($p = .122$) (Smith et al., 2010). The results associated with OC spray and police use of CEDs found that both less lethal instruments were unrelated to police officer injuries. These findings advocate additional research and closer analysis involving police and suspect encounters involving less-lethal instruments.

Use-of-force reports from RCSD, MDPD and SPD were coded to find the defensive weapon used by police officers during physical encounters with suspects and ultimately correlate the force and weapon(s) used to the injuries for both suspect and police officers (Bulman, 2010; Smith et al., 2010). This study provided valuable information about injuries and less-lethal instruments, especially since the three sites varied in location and agency type (municipal police, county sheriff's department), yielding both expected and unexpected findings. The analysis showed that when police officers at all three agencies deployed hands and feet defensive tactics, the likelihood of injury increased, but not significantly at the Seattle Police Department.

The use of OC spray could only be measured in two of the agencies; Richland County Sheriff's Department and the Seattle Police Department, with RCSD showing a reduction in the odds of police officer injury when deploying OC spray and Seattle Police was neutral on OC spray showing no increase or decrease in officer injuries. All three agencies had implemented CEDs, although MDPD only recorded partial deployment and RCSD still relied heavily on OC spray at the time of data collection. Miami-Dade and Richland County reported a reduction in officer injuries when CEDs were deployed, however Seattle Police found no reduction in officer injuries resulting from CED use. The study results suggest that not all law enforcement agencies experiences with less-lethal instruments during suspect encounters are uniform and standard, thus supporting the need for additional research regarding these variables.

Taylor and Woods (2010) conducted a quasi-experimental evaluation of injury rates for police officers over a 4-year period at thirteen law enforcement agencies. Seven of those agencies had adopted CEDs at the time of the study and they were compared to six agencies not using CEDs. Taylor and Woods found that police departments using CEDs reported lower officer injury rates; lower severe injuries for suspects and the rates for both police officers and suspect's injuries were lower than the departments not using CEDs.

In addition to studying the injury rates for officers, this study also examined suspect injuries, associated medical attention, and any need for hospitalization. Since CED use induces temporary incapacitating characteristics, suspect injuries, medical attention (from serious injuries), and hospitalization were also found to be less at the

agencies deploying CEDs than non-CED deploying agencies. Most studies have focused on CEDs and how they compare to other less-lethal weapons, however Taylor and Wood's study provided informative properties regarding the use and non-use of CEDs.

Police Use-of-Force

Police officers often use sanctioned authority to employ force when carrying out their operational duties, making decisions to use the necessary force in order to gain compliance and restore peace with the minimal amount of injury to both the officer and suspect (Lin and Jones, 2009). Police officers exercise a great deal of discretion proportioned to the reasonableness standard derived from the Fourth Amendment when addressing combative suspects (Smith, Petrocelli & Scheer, 2007). Police use-of-force research has primarily focused on deadly force (White & Ready, 2007).

Many law enforcement agencies operate under what is known as a use-of-force continuum, which is a scale of escalating techniques, tactics and weapons guiding use-of-force decisions made by police officers in the field (Hough & Tatum, 2012; Miller, 2010). Some police agencies elect not to adhere to a force continuum and research shows that force continuums may be similar, but are rarely identical from one law enforcement agency to the next. This would be problematic if this study compared or analyzed data based upon the levels of the force continuum among various law enforcement agencies.

Research associated with police officer injuries and less-lethal instruments for law enforcement encompass defensive tactics, impact baton, and the most prevalent tool of the 1990's, the adoption of oleoresin capsicum (pepper spray) (Smith et al., 2007). These tools, with the exception of pepper spray have achieved limited success because they

require the officers to come within close proximity of the resistant and combative suspect (Murgado, 2013; Kaminski & Sorsensen, 1995). The downside to pepper spray is the issue of contamination to the officer, any close witnesses in the immediate area as well as decontaminating the suspect once they are securely in custody (Murgado, 2013).

Following the sweeping adoption of the CED during the 2000s, a study conducted at the Las Vegas Metropolitan Police Department (LVMPD) by Sousa, Ready and Ault (2010) focused on the extent that police officers use CEDs rather than other alternative less-lethal instruments available (hands/feet defensive tactics, OC spray and impact baton). This study utilized a treatment group and a control group in a randomized experiment involving field-training scenarios where a total of 64 patrol officers were randomly assigned to either the treatment or control group.

A pair of police officers were placed in a scenario requiring them to respond to three different levels of suspect resistance; non-aggressive, aggressive and potentially lethal resistance. The treatment group received all the issued weapons (simulated for the study) they are trained on and normally carry during their assigned duties. The control group was also issued simulated issued weapons with the exception of the CED.

The LVMPD employs a use-of-force policy that identifies six levels of suspect behavior dictating the levels of appropriate force. Levels 1 and 2 are designated for compliant suspect behavior to passive resistant; level 3 is designed for suspects exhibiting increased physical resistance and the end of the force spectrum is levels 4 through 6, where the suspect is physically combative with potentially lethal behavior (Sousa et al., 2010). Empirical data showed through use-of-force reports at the LVMPD that CEDs

were used 579 times during 2004 and subsequently coincided with a noted reduction in the use of pepper spray as well as the baton (Sousa, Ready & Ault, 2010).

In every scenario during the LVMPD study, each pair of police officers participating in the study was presented the same three random scenario studies consisting of scenario 1 – non aggressive resistance, scenario 2 – aggressive resistance and scenario 3 – potentially lethal resistance (Sousa et al., 2010). The treatment group and control group were randomly assigned to the groups, and their differences in age, gender, race, years of experience, height and rank were insignificant, except for weight and prior military experience where the control mean weight was slightly heavier and the military experience of the control group was 50% compared to 31% of the treatment group.

The use of less-lethal instruments during the three scenarios each pair of police officers participated in revealed that during a passive and non-aggressive encounter, being armed with a CED did not significantly impact how the officer responded with most officers using hands/feet defensive tactics as a force resolution (Sousa et al., 2010). During the aggressive scenario, CED use was associated with 34.4% fewer applications of pepper spray (11 officers in the control group used pepper spray with no officers in the treatment group using pepper spray). A 28.2% reduction in the use of the impact baton was found (22 officers in the control group deployed the baton compared to 13 officers in the treatment group.

The lethal-resistance scenario showed a statistically significant difference in the groups, with 21.9% of the treatment group and 53.1% of the control group discharged

their firearms. This scenario fell into the highest level (6) on the levels of suspect behavior that the LVMPD follows and deadly force warranted. However, 14 or 43.8% of the officers in the treatment group employed a CED when faced with a deadly force situation. This finding implies that further training for police departments in the application of force as well as complete understanding of their force continuums and suspect resistant levels is warranted.

As the LVMPD address resistant suspects using the 6 levels of suspect behavior approach, other police agencies across the U.S. are applying various levels of force in accordance to their perception of suspect behavior and in relation to their use-of-force continuum (Engel, 2008). It is important and yet far more difficult to accurately assess, measure and understand the use of excessive force (Sussman, 2012). As the law enforcement use-of-force arsenal progresses with developments such as the CED, conceptualizing use of force through a national database has been theorized by many researchers as well as creating a use-of-force standard for law enforcement in an effort to provide and maintain law enforcement use-of-force oversight.

Police officers are expected to use the level of force as well as the appropriate amount of force necessary to gain compliance when addressing resistant suspects while resolving volatile situations (Sousa et al., 2010). The levels of force police officer's use varies according to the dynamics of the incident, and physical force may escalate or de-escalate throughout the encounter. Now that police officers have a cadre of less-lethal instruments available, the decision-making process for police officers may change.

Terrill, Leinfelt, and Kwak (2007) examined use of force at a selected smaller police agency through use-of-force reports and in particular what level of force and type of less-lethal instrument the police officer(s) select as a means of resolving the encounter in comparison to previous research data of larger police agencies. The River City Police Department (RCPD) is a small Midwestern department with approximately 50 sworn police officers and are trained on and carry the following use-of-force instruments; empty hands defensive tactics (hand and foot strikes, pressure points and joint locks), impact weapon, OC spray, CEDs and firearms as well as an additional category including the use of a K9.

Over a 3-year period (2002 – 2004), Terrill, Leinfelt, and Kwak (2007) aimed to answer three research questions regarding the extent of officers' use of force and suspect resistance: (a) How does an officer's use of force and suspect resistance vary within individual encounters? (b) What situational factors influence which type of force used by the officer? (c) What factors influenced the level of force the officer used? For this literature review, the concern is primarily with the use of CEDs, OC spray, impact baton and empty hand defensive tactics.

The total number of arrest encounters (n = 3,264) showed that CEDs were deployed in 58 encounters with OC spray being used during 35 encounters (Terrill, Leinfelt and Kwak, 2007). Empty hand defensive tactics techniques were broken down as to which particular technique was deployed; muscling and wrestling accounted for 514 encounters, joint lock accounted for 169 encounters, body strikes accounted for 45

encounters and pressure point tactics were used during 43 encounters. Handcuffing was categorized as a force type and was recorded as being used during 3,074 encounters.

The River City study supported the trend that CEDs have gained popularity in law enforcement and could gradually replace OC spray as the primary choice of less-lethal instrument (Bullman, 2011). However, it also substantiates that most suspect and police encounters are resolved through empty hand defensive tactics, which has also been related to an increased percentage and likelihood of officers being injuries (Crow & Adrion, 2011; Mesloh, Henych & Wolf, 2008). This study also analyzed an interesting concept of use-of-force combinations, including all the issued less-lethal instruments used by the River City police officers during the same encounter. Of those weapons, the CED was the only force choice that was solely used during the encounters and was not used in combination with another instrument. It was not made clear if the CED was so effective that no other less-lethal instruments were needed or not.

Police officers must quickly respond to emergency situations and they have the responsibility of mediating a wide range of altercations. Volatile situations fueled by emotions, as well as the possibility of drugs and/or alcohol being used by suspects create scenarios for the police that are highly probable to escalate into episodes of violence and the threat of force (Ashley & Golles, 2000; Smith, Kaminski, Rojek, Alpert & Mathis, 2007). Police officers respond to calls to service, traffic accidents, disturbances and a variety of other citizen needs and/or complaints, and given the unpredictability of police work, any of those calls could evolve into a situation where force is deployed and injuries occur.

Evidence suggests that the use of impact weapons are directly associated with injuries to both citizens and police officers (Gervais et al., 1998). Physical encounters between police and resistant suspects usually involve moving and struggling. During these up close encounters, police officers often have to properly deploy some type of less-lethal instrument. Prior to CEDs and OC spray becoming available, the primary less-lethal instrument was the impact baton. When deploying the baton, the goal was to stop the resisting suspect by striking a large fleshy portion of the body and avoiding bones, joints and especially the head area. However, the area aimed for by the police officer may not always be where the baton actually strikes, resulting in sometimes severe injuries often requiring medical attention.

Police use of force has posed a challenge both for police administrators as well as for the officers themselves (Bullman, 2010). Police officers are trained to use force to restrain and redirect the behavior of individuals physically resisting lawful directions (Mesloh et al., 2008). Police officers deploy a wide range of defensive tactics and less-lethal instruments, however Terrill, Leinfelt and Kwak (2007) found that most officers' predominately use hands on tactics such as grabbing, holding and bodily force when addressing a combative suspect. These actions are expected given that so many law enforcement agencies require officers to adhere to a strict force continuum, escalating up the continuum as the suspect continues to resist and become more combative. The force used by the police officer should coincide with the continuum for that particular behavior and often those lines are blurred and not very distinct (Hough & Tatum, 2012).

Police Use-of-Force and Suspect Proximity

The distance between officers and combative suspects during physical encounters is an important component in research on police officer injuries and the use of less-lethal instruments. Police officers receive initial training on maintaining safe distances at all times simply because they are armed with a firearm and are responsible for ensuring they always have possession and control of that firearm. Therefore, proximity is a cornerstone in establishing officer safety. However, as the demands of police work are ever changing, officers must apprehend suspects through the application of less-lethal instruments. In an overwhelming majority of police and citizen encounters, maintaining a safe proximity is equally important for the safety of the officer.

As police officers use hands, feet and their bodies applying defensive tactics techniques, they have completely closed any distance between themselves and the suspect. The officer then utilizes grabbing, striking and compliance holds in order to gain physical control over a combative suspect (Alpert, Smith, Kaminski, Fridell, MacDonald & Kubu, 2011). Defensive tactics are considered a less-lethal use of force and is usually incorporated into the police use-of-force continuum. It is also agreed upon by researchers and practitioners that when police officers use defensive tactics as a means of gaining control of resisting individuals, they are much more likely to receive injuries (Alpert & Dunham, 2010); (Klinger, 2008); (MacDonald, Kaminski & Smith, 2009).

The sweeping adoption of oleoresin capsicum by law enforcement during the 1980's was done so that police officers may have a less-lethal instrument affording them approximately 10 to 12 feet of distance from a resisting suspect (Vilk & Chan, 2007).

The application of OC spray is suggested to consist of a 2-second burst of spray to the eyes of the combative suspect using a full cone spray for maximum incapacitating effects (Morabito et al., 1997).

Oleoresin capsicum did create much desired distance for police officers to address combative suspects, but it was not without a price to all responding officers and sometimes witnesses as well. The delivery system for OC spray is not precise and cross-contamination is always a possibility when OC is used. In addition, a growing number of reports reveal that combative suspects will fight through the burning effects of OC and that OC can be ineffective in these situations resulting in the officer going hands-on with the suspect or using another less-lethal instrument if available (Smith et al., 2010).

With the adoption of OC spray and CEDs, the use of batons in law enforcement have diminished, but are still standard issue equipment at most police agencies. The baton was historically adopted as an alternative means of force for police officers to use, aimed at reducing the use of firearms (Gervais et al., 1998). For police officers to deploy the baton, using compliance holds or striking approved areas, the officer must be in close distance to the suspect approximately 2-4 feet (Messina, 2011). Therefore, the baton does not afford very much distance between the officer and suspect as well as producing severe injuries to the suspect when used.

The CED allows for officers to effectively and precisely deliver the shocking probes from a distance of 21 to 25 feet away from the resisting suspect (Murgado, 2013; Ferdik et al., 2014). This amount of distance between the officer and suspect should provide for a safer situation.

When it comes to police officer injuries, it is agreed upon by law enforcement agencies as well as researchers in the field that the likelihood of officer injury escalates when the distance between the officer and the suspect closes. Anytime there is physical force used during police and citizen encounters, there is a chance of the officer receiving injuries (Bulman, 2011).

Medical Issues and Less-Lethal Instruments

The medical implications of the use of less-lethal instruments is usually the basis for citizen complaints and legal actions against law enforcement (Terrill & Paoline III, 2012). Amnesty International and the American Civil Liberties Union are a couple of the organizations and advocacy groups voicing concerns and commenting regarding the health and safety implications associated with the use of CEDs. A comprehensive group of individuals comprised of various backgrounds and knowledge such as police practitioners, medical experts, and social scientists were brought together by the National Institute of Justice in an attempt to express concerns and evaluate the possibility of serious health injuries resulting from the use of CEDs.

There are restrictions when testing less-lethal instruments, however in an effort to gain a better understanding of the effectiveness of CEDs, controlled medical research has been conducted on both animals and humans (Alpert, Smith, Kaminski, Fridell, MacDonald & Kubu, 2011). Studies focusing on animal testing of CEDs found that shocks lasting five to fifteen seconds resulted in no ventricular fibrillation of the heart. When two shocks lasting 40 seconds each were administered to test animals, they produced an increased heart rate and fibrillation in some of the animals. The human test

subjects (law enforcement trainees) experienced an increased heart rate following exposure, but none of the human test subjects experienced ventricular fibrillation. These test results may pose a foundation for training and policy regarding the actual deployment of CEDs.

Based on the current data available, this diverse study group found no conclusive evidence of serious injuries and deaths associated with the effects of CEDs, regardless of puncture wounds or burns caused by the barbed darts of the device (Terrill & Paoline III). Taylor & Woods (2010) found a reduction in severe injuries to both suspects and police officers at law enforcement agencies that use CEDs as opposed to agencies that do not employ the CED. Their study suggests the use of CEDs play an important role in physical struggles between police officers and suspects by eliminating the close contact necessary to control a combative suspect.

During their study on less-lethal technology, Vilke and Chan (2007) focused on medical issues surrounding oleoresin capsicum, CEDs and impact baton or blunt projectiles (bean bags and rubber bullets) used by law enforcement officers when encountering combative resistant individuals in the field. All three less-lethal instruments allow for the officer to create some distance between themselves and the combative suspect. However, the use of the CEDs placed the officer further away from the combative suspect than any of the other less-lethal instruments observed.

Controversy associated with less-lethal instruments was brought to the forefront during the 1990s with OC spray, derived from the oily extract of pepper plants delivered in either a liquid stream spray, aerosol spray or as a projectile containing powder

(Arizona Department of Public Safety, 2003). Oleoresin capsicum causes irritation to the eyes, skin and mucous membranes and has been the focal point for many advocacy groups questioning in custody deaths following the use of OC. Still a controversial point, a connection between OC exposure and suspect death has not been established nor has evidence been found deeming OC as inherently lethal. Since OC spray is directed at the facial area and particularly the eye area, corneal abrasions can be a symptom of OC spray requiring water irrigation as a decontamination. OC spray remains a standard law enforcement issued less-lethal instrument to address combative suspects while ensuring a somewhat safe distance from the encounter for the officer.

The controversy surrounding CEDs has been grounded in episodes of citizen injuries and death as explained in the 2008 Louisiana incident involving a CED. Any incident where force is exerted has the potential to result in injuries to all participants involved in the encounter. In 2008, a Louisiana police officer was indicted on manslaughter charges when a suspect died after that police officer delivered nine stuns from their issued CED to a resistant suspect (White & Ready, 2009). Subsequently, a Department of Justice inquiry on deaths following electro-muscular disruption found, there was no conclusive medical evidence within the state of current research that indicated a high risk of serious injury or death from the direct effects of CED exposure (White & Ready, 2009).

Similar to research findings, Amnesty International (2007) recognized that in real world settings involving individuals who are agitated, disturbed, and under the influence of drugs and/or alcohol, and may have pre-existing health conditions are at a high risk of

serious injury or death. This poses a limitation to replicate the setting and data for further research on the subject.

Exploring media reports that describe police use of CEDs and gathering data from LexisNexis and the New York Times, White and Ready (2009) used bivariate analysis to compare reported fatal deployments (n = 188) of CEDs with nonfatal deployments (n = 333). Continuing to analyze the data, multivariate analyses including logistic regression and CHAID (segmentation modeling) to identify suspect and incident characteristic predictors of news reports involving CED-related deaths.

This study, although criticized for potential biases and sensationalism presented through media sources managed to find a higher risk of death when the CED was deployed more than once on the same suspect (50.8% vs. 23.3% for nonfatal cases). Addressing this statistical finding, Bunker (2009) recommended training and policy changes for law enforcement in reference to the number of CED applications per suspect based on pertinent literature of CED applications.

Other predictors associated with higher risk of CED-related fatalities was found when suspect resistance did not stop following the deployment (38.8% vs. 22.7% for nonfatal cases), the suspect was handcuffed (in custody), when the CED was deployed (22.3% vs. 6.1% for nonfatal cases), and when the suspect was medically treated at the hospital (58.6% vs. 29.8% for nonfatal cases) (White & Ready, 2007).

An additional finding found that a significant number of fatal incidents involved suspects under the influence of drugs (23% vs. 6.3% for nonfatal cases), mentally ill or emotionally disturbed (36.2% vs. 22.9% for nonfatal cases) and lastly, those suspects not

likely to be armed with a weapon (16% vs. 37% for nonfatal cases). The research conducted regarding fatalities is an essential component for policy development leading to positive social change in regards to citizen and police relations.

As law enforcement has changed with progressive technologies, ideologies and training advancements, the impact baton was adopted as a less-lethal intermediate level of force for police officers. The idea was to have a less-lethal instrument available for officers to carry on their duty belt with the goal of reducing injuries to officers and citizens as well and subsequently reducing the rate at which officers would use their firearms (Gervais, Baudin, Cruikshank, & Dahlstedt, 1998).

CEDs and Officer Injuries

Reducing serious injuries or death for both police officers remains a challenge and a goal for law enforcement agencies (Taylor & Woods, 2010). This challenge continues to be an issue because of the close proximity police officers must maintain when apprehending a combative suspect, resulting in hands-on contact and causing injuries (Fiedler, 2011). As society has evolved technologically, and become more enlightened to human rights, resulting in the need and demand for less-lethal instruments for police officers have increased (Sousa et al., 2010).

The odds of police officers getting injured increases greatly when the distance between the officer and a combative suspect is within an arms-reach (Alpert & Dunham, 2010). Much speculation has risen about whether less-lethal instruments have impacted not only injuries, but the use of deadly force. In response to this, the Columbus Police Department identified 14 incidents in which deadly force would have been used had a

CED not been available for the officer to deploy (Adams & Jennison, 2007). Of those 14 incidents, the police officers did not sustain injuries, the suspects were incapacitated and no lives were lost.

Research during the 1990s supported the adoption and use of OC spray by law enforcement as a less-lethal instrument and the use of pepper spray prevailed throughout the 90s. However, by the year 2000, the focus was on CEDs as the predominately less-lethal instrument emerging and continues to grow in popularity with over 11,000 law enforcement agencies adopting CEDs (Kaminski, 2009; Alpert & Dunham, 2010).

Concern for public safety has initiated controversy with the adoption and deployment of CEDs. The social perception clashes with that of law enforcement agencies perceiving CEDs as a less-lethal instrument used to reduce police officer injury (Paoline, Terrill, & Ingram, 2012). The gravity towards CEDs have all but replaced the impact baton with many law enforcement agencies and has gradually surpassed OC as the less-lethal instrument of choice by most police officers when placed in a potentially violent encounter (Mesloh, Henych, & Wolf, 2008).

The pre- and post-CED adoption (time series) analyses have been conducted at several police agencies. A leading study contributing to time-series analysis of CEDs was conducted by MacDonald et al. (2009) examining officer injury reports for a 9-year period at the Orlando Police Department (OPD). In addition to OPD, the Austin Police Department (APD) in Texas was studied for a 5-year period. Reports from both agencies examining the average monthly incidence of police officer injuries prior to and following the adoption of CEDs were analyzed. Both police agencies reported a decrease in officer

injury averages during the study time. Orlando reported a decrease of officer injuries of 62% following the adoption of CEDs, while Austin found a 25% reduction.

One of the first quasi-experimental studies focusing on CED use and police officers was conducted by Taylor, Woods, Kubu, Koper, Tegeler, Cheney, Martinez, Cronin and Kappelman (2009) with dates ranging from 1999 thru 2007. The data collected for this study originated from use-of-force incident reports at all the participating agencies and utilized a multivariate analysis of the following measures: officer injuries, officer injury severity, officer injury from a force incident requiring medical attention, officer injury from a force incident requiring hospitalization, suspect injuries, suspect injury severity, suspect deaths, suspect injury from a force incident requiring medical attention, and suspect injury from a force incident requiring hospitalization (Taylor, Woods, Kubu, Koper, Tegeler, Cheney, Martinez, Cronin, & Kappelman, 2009). The data for this study compared incidents of force at law enforcement agencies deploying CEDs (n = 7) to non-CED issuing agencies (n = 6).

The results from this study showed that CEDs significantly impacted the reduction of officer injuries (8% of police officer injuries in the post period to 20% for the non-CED sites) (Taylor et al., 2009). In addition to these findings, agencies using CEDs are over 70% less likely to be injured and when officers at the CED issuing agencies deploy the CED, there was a 76% reduction in officer injuries.

Lin and Jones (2010) studied officer injuries from a different perspective, looking at officer injuries, CED use and other use-of-force methods. Use-of-force reports covering a 3-year period at the Washington State Patrol (WSP) were examined during the

study period. This study aimed at answering the following questions: which use-of-force methods were replaced by the adoption of the CED. Did the adoption of CEDs reduce the use of lethal force and the number of types of force employed in use-of-force incidents? This research also set out to determine officer satisfaction regarding the effectiveness of CEDs during arrest encounters.

The results of the WSP study found that CED use replaced only other less-lethal instruments: OC/chemical spray, personal weapons, takedowns and total limb controls, but did not replace the use of lethal force. The WSP officers gave CEDs high ratings in regards to effectiveness, however the officers perceived takedowns and total limb controls as more effective. WSP officer injury rates were impacted by the adoption of CED, with a decreased officer injury rate of 47% (Lin & Jones, 2009).

The WSP study provided information driving policy matters impacting the adoption of CED based on police and suspect injury data as well as the dynamics regarding use of less-lethal force. Given the widespread popularity of CEDs in law enforcement, it is vital to continue research on the practical use of CEDs as well as ensuring proper training strategies and policies accompany the adoption of CEDs.

Injuries to police officers continue to present issues for police agencies as well as affecting the public. In an effort to determine the effect of less-lethal instruments, CEDs and OC spray on injuries to both police officers and citizens during police use-of-force events, MacDonald, Kaminski and Smith (2009) analyzed data from 12 police agencies injury reports documenting injuries to officers and civilians in 24,380 cases.

Additionally, the monthly injury rates for 2 of the police agencies before and after CED adoption (time-series analysis) was examined as well. The narrative description from the reports provided the following quantifiable data: injuries that officers and suspects received, suspect's level of resistance and the level of force used by the officer during the encounters. The suspect resistance was measured as either passive, active aggressive or aggravated. The physical force used by the police officers was defined as using either hands, fists, or feet; impact weapon or flashlight; use of OC or CEDs (MacDonald et al., 2009). Less than 1% of the cases studied resulted in the use of a firearms, therefore those cases were removed and not analyzed. However, the need for less-lethal instruments is further supported in the wake of such a low deployment of deadly force.

In addition to suspect resistance and physical force used by the officer and officer/suspect injuries, the researchers analyzed law enforcement policies regulating the use of CEDs and OC. In doing this, they utilized a dichotomous variable coded 1 for a more restrictive OC or CED policy use (use of OC or CED on defensive suspects or greater resistance) or 0 for a lesser restrictive policy where OC or CEDs could be deployed on passive or verbally resistant suspects. To adhere to reliability, each police agency indicated whether their officers were authorized to use either OC or CEDs under their respective use-of-force policies during five hypothetical and identical scenarios used for this study. Bishopp, Klinger and Morris (2014) collected officer injury data from the Dallas Police Department in an effort to analyze officer injury following a more

restrictive policy regarding the CED. The results of this study showed a slight increase in monthly officer injuries.

Officer injuries were found to be significantly less than suspect injuries at 14% for police officers and 38% for suspects when OC or CEDs were used coupled by a more restrictive use-of-force policy. However, if the suspect exhibited resistance, injuries to police officers increased to 21.2%. An overall reduction of suspect injuries of 69% was found when officers used OC or CEDs. Injuries to police officers increased slightly when OC was used to 28.3%. Injuries to both police officers and suspects decreased under the more restrictive use of force policies, but suspect injuries increased slightly by 12% for agencies with the lesser restrictive use-of-force policy. Injuries were reduced by an overall 38.5% for agencies following adoption of the CED.

Differences in department policies restricting the use of OC or CEDs showed no relationship between OC or CED use and the type of injury received by the officer or suspect. The greatest chance of police officers getting injured while addressing resistant suspects occurs when the officer attempts to restrain and control a suspect by using hands on techniques; kicking punching, take downs and wrestling (Alpert & Dunham, 2010). It is conceivable since 70% of police officer injuries are the result of close quarter contact, and is the primary reason less-lethal instruments such as CEDs and OC spray has been so widely adopted by police agencies is in response to the health and safety of citizens and law enforcement officers (Paoline, III & Ingram, 2012; Smith et al., 2007; Vilk & Chan, 2007).

Police use of force has changed over time and those changes were documented in a study surveying law enforcement agencies beginning in 2003 and ending in 2008. The goal of that study was to track the types of less-lethal instruments, force level used by the participating agencies, excessive force complaints, and injuries to police officers and suspects in an effort to provide law enforcement executives and policymakers with informative trends in less-lethal instruments (Taylor, Alpert, Kubu, Woods & Dunham, 2011). To ensure a comprehensive study, the researchers used statistical weights to align the data so that all state and local law enforcement agencies are represented in the study. Measures were also implemented to address agencies that did not respond to the survey.

Closed-ended questions made up the survey questions about the use of less-lethal instruments: impact baton, CEDs, OC spray and other impact munitions (Taylor et al., 2011). The type of force used by the responding agencies was far more encompassing ranging from firearms used against citizens, all the previous listed less-lethal instruments, flashlight, empty hand tactics, as well as pointing a weapon at individuals, neck restrains, canine bites and vehicle ramming. The size of the agencies surveyed ranged from 1 sworn officer up to 13,400 officers from across the United States (Northeast, Midwest, South and West).

The citizen populations of the responding agencies were fairly balanced across small, medium and large jurisdictions. The trend of CED use and OC spray reducing the use of firearms, general use-of-force incidents, injuries to officers and suspects as well as reducing citizen complaints of excessive force were noted. The absence of systematic tracking pertaining to the level of force, complaints of excessive force and injuries to

officers and suspects impacted the data collection and analysis producing a variety of findings.

The analysis of the data found the available weapons in 2005, OC spray was the most likely to be available with 92.6% of the agencies issuing OC, followed by the expandable baton at 78.5% and the CED at 53% (Taylor et al., 2011). The survey data from 2008 showed a decrease for the availability of expandable baton from 78.4% in 2005 to 75.1%. The use of OC spray decreased as well from 92.6% in 2005 to 86.5% in 2008. The availability of CEDs increased to 69.1% in 2008 from 53% in 2005. The trends of this study revealed decreased use of OC and the impact baton as CED use increased.

The survey data found the use of batons and empty-hand defensive tactics are being less commonly used by police officers with CED use ranked as the most used less-lethal instrument from 2005 to 2008. The choice of less-lethal instruments, according to the data had little impact on officer injuries from 2003 to 2008, as suspect injuries increased supporting previous literature on officer and suspect injuries (Smith et al., 2007).

A limitation of the findings for this study regarding police officer injuries should be noted that roughly only 20% of the responding law enforcement agencies utilize an adequate database for the collection of injury reports. Nonetheless, the study contributes details and facts to police use of less-lethal instruments that should not be ignored while reviewing literature on less-lethal instruments.

Policies and Police Use-of-Force Continuums

Public concern and attention to police use of force necessitates the need for structured policy development guiding CED use and the role CED's occupy in law enforcement (Adams & Jennison, 2007). It is suggested by the International Association of Chiefs of Police (IACP) that police agencies not only develop policies for the proper use of CEDs, but should also develop policies stipulating when the use of CEDs is inappropriate as well (Alpert & Dunham, 2010). The use of CEDs on fleeing subjects, persons suffering from psychological disorders, vulnerable populations such as juveniles, and the elderly and pregnant women should be clearly addressed in policy. The policy would subsequently provide guidelines for training mandates as well as qualification and recertification requirements for police officers.

Police agencies are regulated by policy and procedures guiding the officers on topics ranging from uniforms and equipment to the amount of force to be used under various circumstances (Alpert & Dunham, 2010). Since the first published use-of-force policy by the International Association of Chief of Police in 1989, law enforcement agencies have taken various approaches in adopting use-of-force policies, with some agencies allowing their use-of-force continuum to stand as a guiding policy (Hough & Tatum, 2010). Other agencies go to great lengths to compose detailed and concise policies.

There are no consistent use-of-force standards or use-of-force continuums mandated for law enforcement on a local, state or federal level (Thomas, Collins, & Lovrich, 2012). This lack of continuity regarding policy and use of force establishes the

need for policy development, implementation, training and evaluation procedures for CEDs and use of force in general (Adams & Jennison, 2007). Policy guiding the use of CEDs should be encompassing of standards in alignment with state and federal laws: Graham v Carroll, Tennessee v Gardner and the Fourth Amendment (Hough Sr., & Tatum, 2010).

Since there is no standardized policy for law enforcement agencies regarding use of force, agencies adopt and implement their own use-of-force policy and often in combination with a use-of-force continuum (Hickman, Piquero, & Garner, 2008; Hough & Tatum, 2012). The Johnson City Police Department (JCPD), which provided data for this study, like other law enforcement agencies does not have a separate policy regarding the use of CEDs, but instead has incorporated the use of CEDs in their use-of-force policy that encompasses and outlines their use-of-force continuum. Therefore, the JCPD use-of-force policy was evaluated from the data gathered and analyzed for this study.

The officers at Johnson City are trained based on their use-of-force policy that states the following: "The value of human life is immeasurable in our society. Police officers have been delegated the awesome responsibility to protect life and property and apprehend criminal offenders. The apprehension of criminal offenders and protection of property must, at all times, be subservient to the protection of life. The officers responsibility for protecting life must include his or her own." (Johnson City Police Department, 2013, p. 2). The Police Department has eight levels of response by officers in their use of force policy:

1. Physical presence;

2. Verbal command/dialogue;
3. Compliance holds;
4. Taser (CED)/chemical agent;
5. Mechanical compliance;
6. Hands and feet impact;
7. Impact weapon; and
8. Deadly force – when policy criteria are met (Johnson City Police Department Use of Force Policy, 2013, 23).

The placement of CEDs on the use-of-force continua is based on various use-of-force outcomes. If the CED is placed too low on the continua, higher rates and frequency of use on suspects that passively resist will occurs (Ferdik et al., 2014). According to study findings by Ferdik, Kaminski, Cooney and Sevigny (2014), CED placement on the use-of-force continua was not positively related to the perception that CED use lowered the use of deadly force incidents by law enforcement.

Additionally, when the CED was placed higher on the force continua, fewer CED deployments were recorded. In 2004, the Phoenix, Arizona Police Department found that following the implementation of CEDs to all their officers, significant reductions in the use of deadly force incidents were noted. However, Phoenix experienced an overall increase in use-of-force incidents by 139% during the same time period (Thomas et al., 2012).

The objective of the force continuum is to function as a use-of-force guide for police officers executing lawful duties utilizing the least amount of force necessary

(Hough Sr. & Tatum, 2012; Johnson City Police Department Use-of-Force Policy, 2013). The Johnson City Police Department has placed the CED at the fourth level on their use-of-force continuum. They have also placed the use of chemical agents/OC pepper spray at the same level as CEDs, allowing the police officer to exercise discretion in which less-lethal instrument they deploy.

The importance of managing how police use force was demonstrated through the previously discussed study at the Orlando Police Department conducted by Miller (2010). Data was collected during the pre-test period: June 2003 – June 2004 and following a use of force policy change: post –test period; June 2004 – June 2005. The policy change following this study dictated the use of CEDs only when suspects were actively resisting by pulling away or fleeing a violent confrontation and not when suspects were passively resisting.

The use-of-force reports analyzed at the Orlando Police Department presented the levels of resistance by suspects along with the level of force used by the police officers. Following the policy change, police calls for service increased by 13.6%, while CED use dropped from 523 deployments to 367. The drop in CED use decreased suspect injuries by 31%, however police officer injuries increased by 12.5%. These percentages are explained through the documented higher levels of active and aggressive resistance the officers experienced (Miller, 2010).

There are no universal standards regarding police policy implementation, training standards and requirements for reporting and maintaining records. However, policy change should be accompanied by training provisions and reporting requirements to

ensure compliance with written directives supporting policy infrastructure (Chermak, 2009; McEwen, 1997).

Law enforcement policies on use of force should not be conceptualized through a static response, but rather through a research-supported policy and/or a flexible continuum ranging from officer presence and verbal commands up to the highest level of force, which if necessary is deadly force (Mesloh, Henych & Wolf, 2008). However, the flexibility and officer's use of discretion should be accompanied with supervisory oversight in alignment with the agencies policies. Training and a thorough understanding of the progressive levels of the continuum and the departmental policies is necessary to ensure officers apply only the necessary force to achieve the lawful objective to result in the least amount of injuries (De Angelis & Wolf, 2013; Morrison, 2009).

Summary

Research on the subject of police use of force through less-lethal instruments has been compiled for several years and in particular, the instruments used during citizen encounters. With the introduction of each less-lethal instrument to law enforcement, the challenge of proximity between the officers and suspect when deploying the instrument is central to officer injuries and safety.

Since the introduction of CEDs to the law enforcement community during the early 2000's, researchers have evaluated the effectiveness on a wide range of dimensions including police officer injuries, the medical and health implications for suspects, the appropriate position CEDs should take on the law enforcement force continuum and police policy guiding CED use.

Most research studies focused on the effectiveness of CEDs through evaluating suspect and officer injuries before and after adoption of the CED. In addition, studies compared suspect and officer injuries in law enforcement agencies that have adopted CEDs to those that have not. The police agencies in the research studies are diverse and vary significantly in their demographic compositions. Regardless of the vast difference in sampled agencies in the literature, findings in a majority of the studies analyzing CED use suggested that the use of CEDs reduced police officer injuries.

It is difficult to randomize the dynamics of police encounters resulting in injuries to either the officer or citizen, therefore most studies focused on this topic are conducted using a quasi-experimental research design. The examination of large police agencies similar to the study conducted by Smith, Kaminski, Alpert, Fridell, MacDonald and Kubu (2010) where multi-methods including cross-sectional comparison and logistic regression were employed through a longitudinal analysis and a quasi-experimental approach. As research on police officer injuries have become more prevalent, the use of less-lethal instruments used by law enforcement in relation to police and citizen physical encounters warrant closer examination.

Chapter 3: Research Method

Methodology

This study tested the null hypothesis by analyzing secondary data reported in the Johnson City Police Department's Suspect Resistant Reports in order to examine the existing policy on the use of less-lethal instruments. The purpose of this quasi-experimental study was to examine whether the use of less-lethal instruments, such as conducted energy devices, oleoresin capsicum, impact batons, and hands/feet defensive tactics reduced injuries to officer at a medium-sized police department in a southern state. The JCPD adopted the Suspect Resistant Report in 1993 replacing a traditional use-of-force report. The Property Management Unit for the Police Department is the official custodian of all police reports including the Suspect Resistant Report. The Property Management Unit undergoes an annual intensive inspection by an outside and independent auditor during the annual comprehensive city audit as well as during CALEA Re-accreditation. The audit ensures the City is compliant with records accountability and storage as well as maintaining the integrity of all city reports.

Since the study analyzed existing data which is beyond the manipulation and control of the researcher, a quasi-experimental design was employed to compare each less-lethal instrument and to test the null hypothesis. The sample units in this study were interactive events between an officer(s) and resistant suspect(s) presented in Suspect Resistant Reports which document the use of a less-lethal instrument. Each reported event is considered a unit of analysis.

The type of less-lethal instrument served as the independent variable, including mutually exclusive groups of less-lethal instruments available to all police officers at the JCPD during the data collection period. The variable consists of four attributes: hands/feet defensive tactics, impact baton, OC spray, and CEDs.

Each attribute constitutes a less-lethal instrument, but each instrument is unique in how it is used by police officers and how it has impacted police use of force. The instruments are defined by their individual characteristics that allow them to be represented numerically so that this categorical variable was analyzed on an ordinal level. The less-lethal instruments are ranked as follows: hands/feet defensive tactics = 1, impact baton = 2, OC spray = 3 and CED use = 4.

Hands/feet tactics

Hands/feet tactics are very likely to be used during a physical encounter between a police officer and a suspect. Police officers are trained to use the least amount of force in graduated intervals. The use of hands and feet tactics is considered an entry-level use of force on the continuum. All Johnson City police officers receive mandatory training on the use of compliance holds and hand strikes.

However, proximity to the suspect using hands and feet defensive tactics place officers closer than any other less-lethal instrument. Since close proximity encounters are associated with a higher chance of injury, other less-lethal instruments are safer.

Impact Baton

The impact baton has been a standard piece of equipment since the early 1900s. For years it was the only less-lethal instrument. Then, as now, the impact baton is an

alternative to hands and feet defensive tactics with physically combative suspects when deadly force is not justified. While the impact baton allows for only slightly more distance from the suspect, it was a well-received alternative when no other less-lethal instruments were available.

The use of the impact baton during police and citizen encounters have historically resulted in minimal injuries to the officer, but this fact is overshadowed by the likelihood of serious and possibly lasting injuries to the suspect. Therefore, the use of the baton has fallen under careful scrutiny in most police agencies, and the judicious use of this instrument is encouraged. With the introduction of oleoresin capsicum to law enforcement during the 1990s, OC spray began replacing the impact baton as the less-lethal instrument of choice by most police officers.

Oleoresin Capsicum

Oleoresin capsicum is an effective less-lethal instrument for law enforcement in that it provides adequate distance between the police officer and the combative suspect. This is accomplished through an incapacitating burst of OC allowing law enforcement to safely apprehend combative suspect(s). From a law enforcement stance, the use of OC was a better less-lethal alternative than the impact baton in that more distance between the police and suspect was created as well as minimizing serious and lasting injuries associated with the baton.

The popularity of OC spray was evident with the widespread adoption and use by law enforcement agencies, but the use of OC spray produced cross-contamination issues with the hand-cuffing and handling of sprayed individuals. Following the deployment of

OC spray, officers must decontaminate the sprayed suspect as well as in most cases themselves following the arrest and prior to incarceration.

CED

The CED is the final less-lethal instrument to be ranked and evaluated. CEDs are currently the most prevalent less-lethal instrument among law enforcement agencies. The CED allows police officer's to create the greatest amount of distance between themselves and combative suspects than the other less-lethal instruments. When utilizing the CED, suspects are temporarily incapacitated and feel pain only when the CED is being used. The suspect does not experience serious or lasting injuries. Unlike OC spray, CED use does not result in cross-contamination or a situation where the suspect or police officer must decontaminate. These are among the reasons, along with CED's reducing police officer injuries that law enforcement agencies have chosen to equip their officers with CEDs as a less-lethal instrument.

The data was treated with appropriate statistical procedures considering the assumptions, the research question and the hypothesis. Empirical objectivity was applied through the rules of scientific reasoning coupled with statistical evidence generated from this study (Vogt, 2007). The data was analyzed at a .05 level of significance and along with the cross-tabulation and chi-square analysis contributed to the rejection of the null hypothesis. The results and conclusions communicated the empirical findings derived from scientific knowledge of less-lethal instruments impacting police officer injuries through tables displaying the statistical evaluations.

Variables

Variables are distinct analytically by whether they are treated as dependent (DV) or independent (IV). The characteristics of the variable determined where they fall within the research design, how they are measured and their ability to explain the research. Injuries to police officers during suspect encounters continue to pose issues for police agencies throughout the U.S. and remains a challenge for police administrators and policymakers.

In order to examine the concept of suspect and police encounters and police officer injures, less-lethal instruments is the categorical independent variable using ranked categories including: hands/feet defensive tactics, impact baton, OC spray and CEDs. Police officer injury is the dichotomous dependent variable utilizing nominal-level data.

To understand and explain the dynamics of officer injuries is a key component in policy development. Research informs and steers police agencies to achieve a safer and more productive direction regarding use of force, resulting in a positive impact on police and community relations. The dependent variable (DV) is officer injury and is a binary variable operationalized by assigning a numerical code 1 for officer injured and 0 for no injury. The Suspect Resistant Report does not provide the extent or severity of the officer's injury warranting future research on that topic, developing an understanding of the types and severity of police injuries. Since the JCPD equips every sworn officer with multiple less-lethal instruments, the independent variable is a categorical variable consisting of hands/feet defensive tactics, impact baton, OC spray and CEDs.

The independent variable is operationalized through four rank-ordered categories based on the proximity that each of the four less-lethal instruments enables the officer to maintain from the resisting suspect. Hands/feet defensive tactics place the officer closest to the resisting suspect with no distance separating the officer and the suspect, therefore it was assigned number 1 in the rank order. The impact baton places the officer approximately 2–4 feet away from the suspect and was assigned as number 2 in the rank order. Oleoresin capsicum was placed 3rd in the rank order because OC spray allows for officers to maintain 10 to 12 feet of distance from the resisting suspect. CEDs were assigned number 4 based on the 21 to 25 feet of distance CEDs provide officers away from the suspect (see Figure 1).

Physical Distance (Rank)	***No Distance (1)***	***2-4 Feet (2)***	***10-12 Feet (3)***	***21-25 Feet (4)***
Less-lethal Instrument	Hands/feet	Impact Baton	OC Spray	CED

Figure 1. Effective distance of each less-lethal instrument.

A cross-tabulation analysis and the chi-square test were conducted to determine if the variables are related and if the relationship is significant respectively. The chi-square test provided statistical evidence regarding which less-lethal instrument resulted in fewer police officer injuries at the JCPD. The analysis comparing CEDs and other less-lethal instruments revealed that police officers receive fewer injuries when CEDs are deployed than when other less-lethal instruments were used.

This analysis calculated coded data representing the dependent variable, police officer injuries. Each less-lethal instrument, which comprised the categorical independent variable used the following ranked categories: hands/feet defensive tactics, impact baton,

OC spray and CEDs (Frankfort-Nachmias & Nachmias, 2008). Statistical conclusions were attributed to properly operationalizing the variables and conducting the appropriate analysis.

Research Design and Methods

The purpose of this quasi-experimental study was to examine whether the use of less-lethal instruments, such as conducted energy devices, oleoresin capsicum, impact batons, and hands/feet defensive tactic reduced police officer injury during confrontations with uncooperative suspects at a medium-sized police department in a southern state. The quasi-experimental research design chosen for this study allowed for comparing the likelihood of police injuries by the use of four types of less-lethal instruments. The sample events for this analysis was collected from all Suspect Resistant Reports beginning in January 2005 and ending in December 2014. During this time period, all Johnson City Police officers, the target population of approximately 149 officers were trained and issued all four less-lethal instruments listed in the independent variable.

The sample selection for this study consisted of reports documented by police officers and approved by supervisors where the officer utilized one of the above four less-lethal instruments. While this study focused on CEDs, other less-lethal instruments available to all JCPD officers were examined to answer the question, has the use of CEDs resulted in fewer officer injuries than the use of other less-lethal instruments? To answer this question, the following hypotheses were tested:

H_0 1: There will be no significant difference in reported police officer injuries when police use CEDs on combative suspects than when police use other less-lethal instruments.

H_0 2: There will be significantly less reported police officer injuries when police use CEDs on combative suspects than when police use other less-lethal instruments.

Law enforcement encounters are unpredictable, and for a researcher to gather data from an observational perspective is very challenging. To physically interject an observer into police and citizen encounters may unduly influence the situation as well as the choices made by the police officer, especially when the observation is focused on the level of force the officer deploys. The cases for this study were not randomly assigned within the comparison categories of the independent variable, and while randomized clinical trials using an experimental design may be optimal for evaluating data, the impact of CEDs was best studied through secondary data.

To test a causal hypothesis through a categorical independent variable, a quasi-experimental design is best suited to structure this scientific study. Studying treatment applications are usually characteristic of quasi-experimental approach, however a quasi-experimental design is also utilized in the absence of a treatment group, as with this study. The number of cases examined for this study was 504 with 95 cases excluded due to the use of multiple less-lethal instruments. The data was collected from reports beginning in January 2005 and ending in December 2014. Concern for internal validity brought about by the lack of randomization was addressed through the data analysis

techniques and how each variable was treated (Frankfort-Nachmias & Nachmias, 2008). The use of archived data reduced the possibility of researcher biases (Vogt, 2007).

The JCPD provided archived Suspect Resistant Reports stored securely by the Property Management Unit. All recorded Suspect Resistant Reports during the time period under evaluation where one or more of the less-lethal instruments were analyzed and included in the data analysis. Since only one police agency was examined, there were no variations in how incidents are recorded, no variations in policy regarding less-lethal instruments, or no incompatible timeframes for data collection adversely affecting the comparison (MacDonald et al., 2009). However, the lack of randomization brings up issues of validity and self-selection effects. To address this issue, the data sampling pool is large, and spanned a significant amount of time.

Cross-tabulation, chi-square test and odds ratio were used to evaluate nominal-level data comparing observed frequencies to expected frequencies determining if there is a significant relationship between the categorical variables. The cross-tabulation used rows and columns forming a matrix of cells containing the coded sampling units from the Suspect Resistant Reports finding a pattern of interaction. Two rows were used indicating whether an officer was injured or not injured during an encounter using a particular less-lethal instrument. Four columns were used identifying each less-lethal instrument and the frequency at which the instrument was deployed.

Totals from the rows and columns produced the marginal distributions of the total, providing percentages of police officers injured and not injured during the use of each less-lethal instrument (McHugh, 2013). Further testing utilizing the chi-square test

was required once the category for the impact baton was combined with the category of hands/feet defensive tactics. This was done to guard against the risk of violating a statistical assumption because the impact baton was used singularly in only three police and citizen encounters.

The chi-square test is a nonparametric test used to evaluate the relationships found in the cross-tabulation analysis. To compute the chi-square test, the expected frequencies of each cell is subtracted from the observed frequencies, square them and divide by the expected frequency of the cell, producing the sum of the cells. To obtain the expected frequencies for a particular cell, the row total will be multiplied by the column total and divided by the sample size (Beals, Gross, & Harrell, 1999). Once these calculations have been done, the chi-square statistic was used to compare the expected and observed frequencies.

Odds ratios was used to measure the size of the effect providing further interpretation of the relationship between police officer injury and less-lethal instruments. The test calculated the odds/probability by dividing the probability of an officer receiving injuries by the probability of that phenomena not occurring (Vogt, 2007). Odds ratios provided the strength of the cross-tabulation and chi-square tests. All statistical analysis was conducted using the SPSS version 21.0.

Considering the probability of either a Type I (rejecting a true null hypothesis) or Type II (accepting a false null hypothesis) error, a .05 significance level was set. The chi-square Goodness-of-fit test was calculated using the four categories and a software package identified as G* Power concluded that the sample size of 88 was required for a

2x4 contingency table with a medium effect size *(w* = .3) in order to achieve a power level of .80 (Faul, Lang & Buchner, 2014). The degrees of freedom determining the sampling distribution was determined by calculating the number of rows minus one then multiplied by the number of columns minus one. Since this study utilized two rows and four columns, the degrees of freedom is *df* = 4. The appropriate minimum value of the calculated chi-square required to reject the null hypothesis along with the level of significance shown in table 4 in Chapter 4. The calculated chi-square was greater than the tabled chi-square value, the null hypothesis was rejected.

Results from this study has provided significant statistical findings for medium-sized law enforcement agencies regarding the use of less-lethal instruments and the likelihood of police officers sustaining injuries when those instruments are deployed. In particular, this study compared the use of CEDs to other less-lethal instruments. However, as a cautionary note, utilizing data from one police agency as this study did, may pose a threat to external validity in that the findings and conclusions may not be reflective and may not be generalized to other populations or situations.

Data Collection

Johnson City Police Department (JCPD)

Data from the JCPD was examined for this study. The JCPD is situated in the Southeastern part of the United States and in the Eastern most part of Tennessee. Johnson City has a citizen population of approximately 60,000 and is an industrial city with three major hospitals, a large university and strives for progressive urban development.

During a portion of the data collection time period at JCPD, specifically 2005 and 2006, the officers were cross-trained as firefighters as part of an initiative that began during the early 1970s called the Public Safety Program (PSP). The Public Safety Program required all sworn police officers to be cross-trained as state-certified firefighters, and must respond with the fire department units within their patrol area to all emergency fire calls. Under the Public Safety Program, police officers were still responsible for answering calls to service, patrolling designated zones within the city, making arrests and carrying out all lawful duties of a sworn police officer. The PSP was discontinued during 2006 when the JCPD returned to a traditional police department again. The design of the Public Safety Program was not to divert law enforcement protection, but rather to augment the City's fully staffed fire department.

The JCPD employs approximately 149 sworn police officers and 26 civilians supporting the police department. The JCPD is an accredited law enforcement agency through the Commission on Accreditation for Law Enforcement Agencies (CALEA). Earning the certification of accreditation for a police department requires close adherence to a written set of directives gained through a rigorous evaluation of the police department's standards and procedures. General and special orders unique to each police agency are developed and subsequently undergo the process of accreditation. The CALEA adopted directives state and guide regulations and policies on all activities of that particular agency (Commission on Accreditation for Law Enforcement, 2014).

The strict standards of CALEA require law enforcement agencies to collect and maintain a variety of archival information including documented reports and statistical

data. These stringent requirements aid the operational preparedness of the police agency as well as contributing to enhanced relationships between the police and community (Commission on Accreditation for Law Enforcement, 2014).

The CALEA requirements also hold the JCPD accountable for maintaining accurate reports, which subsequently may limit risk and liability while pursuing professional excellence. The strict adherence to documenting and maintaining the secondary data were used for this study and contributed to the authenticity and validity of this research. Permission to collect data was requested and granted from the Chief of Police. To ensure compliance with properly maintaining the integrity of their reports, during data collection, the Suspect Resistant Reports were not removed from the police department building or photocopied. Further measures will be discussed in the ethical section of this study.

Suspect Resistant Reports

Police officers at this agency have been required to document information on incidents where they receive injuries while on or off duty as well as documenting any level of force on a suspect resistant report since 1993, when the SRR was adopted by the JCPD. The data that was collected from information documented on archived Suspect Resistant Reports, and in other police agencies this particular report may also be known as the use-of-force report (Johnson City Police, 2015). Each Suspect Resistant Report will be considered a sampling unit and assigned a numerical identifier for purposes of analysis as well as anonymity for individuals listed in the reports. The SRR documents information

about an incident involving use of force including whether the officer received injuries, along with suspect and witness information.

CEDs were adopted by the JCPD in December 2004 and the data collection period for this study covered the years beginning in January 2005 and ending in December 2014. The Suspect Resistant Report was utilized throughout the data collection period. Every Suspect Resistant Report unless those reporting the use of a K-9, force by using a vehicle, deadly force or the use of multiple less-lethal instruments during an incident was properly coded and analyzed for this study.

The sampling units for analysis included data regarding the deployment of less-lethal instruments including CEDs, OC spray, impact baton and hands/feet defensive tactics and whether a police officer was injured. Sampling units documenting deadly force, K-9 deployment, vehicle force used, no force used or multiple less-lethal instruments used during one incident were excluded. The JCPD operates two 12-hour shifts per day; with the day shift beginning at 5:35 A.M. and ending at 6:00 P.M., subsequently the night shift begins at 5:35 P.M., and ending at 6:00 A.M. with a 25-minute roll call for the purpose of updates and information sharing incorporated into the shift change.

The use of secondary data provided information regarding the type of less-lethal instrument used by the police officer. The less-lethal instrument was ranked into the appropriate category for analysis. Police officer injury (if any) was also recorded and evaluated using nominal-level data. Ethical considerations for collecting data was addressed through properly coding each sample unit. Each data file was assigned a

numerical identifier to ensure anonymity of all real persons (suspects, victims, witnesses and police personnel) listed on each Suspect Resistant Report.

Data Coding and Methods of Analysis

Coding of data for this study included a meticulous review of each Suspect Resistant Report produced on written reports from the designated collection dates. A coding template consisting of four categorically-ranked variables was created and documented in a data codebook listing the category names, labels, value labels for each category. There were no changes made to the dataset such as creating new categories or fixing categories to accurately collect data from the reports. However, further analysis was conducted once the categorical variables hands/feet defensive tactics and impact baton was combined. There was only three sample units for the impact baton during the data collection period and therefore this category was collapsed into the hands/feet category to avoid the risk of violating a statistical assumption of adequate sample size.

To ensure consistent coding, reports were randomly selected for the purpose of coding verification and reliability. Concern was also given that data from each report was not duplicated, missing or inaccurate. All data collected was entered into SPSS to expose errors in coding as well as analyze the data for predictive and probability values (Vogt, W. 2007). Since the focus of this research is on less-lethal instruments, any reports documenting the use of K-9 deployment, use of force with a vehicle, deadly force, or multiple less-lethal instruments used during an incident was excluded from the analysis.

Officer injury is the dependent variable and was measured as a dichotomous variable coded 1 if the officer was injured during the suspect/officer encounter and 0 if

the officer was not injured. The independent variable is a categorical variable consisting of rank-ordered categories of less-lethal instruments ranked according to the physical distance and proximity that the instruments enable the officer to maintain from the resisting suspect.

Cross-tabulation analysis was used for tabulating results of one variable against another variable using nominal data. The chi-square test is a nonparametric test used to evaluate the relationships for significance found in the cross-tabulation analysis. Odds ratios was used to provide the strength of the cross-tabulation and chi-square tests. Reported in chapter 4, using the cross-tabulation analysis, the chi-square distribution, and odds ratio test, the appropriate minimum value was determined and subsequently the null hypothesis was rejected (Vogt, 2007).

Ethical Concerns

Regardless of the purpose, problem statement, research questions or data collection methods, researchers have the profound responsibility to respect the participants and the research site being studied (Booth, Colomb, & Williams, 2008). The research site where the data was gathered is an accredited police department that maintains all recorded Suspect Resistant Reports managed by the Property Management Unit at the Police Department. The JCPD adheres to a high level of ethical consideration for the security of personal information. Ethical research encompasses many levels of attention and was the focus throughout this project.

It was imperative to have an informed and transparent agreement from the officials at the City of Johnson City responsible for the safekeeping of the reports that

was used in this study in order to have access to the data at the research site. Secondary data gathered from archived reports was analyzed and no human subjects were interviewed or observed. To protect the identities of the suspects, witnesses and police officers listed on the reports, sampling units were assigned a numerical identifier to protect personal information. Additionally, no Suspect Resistant Reports were photocopied or removed from the premises of the Police Department.

Studies involving human participants require the use of an informed consent document between the researcher and participant stating the procedures and risks involved with the study. There were no study participants interviewed or observed in this study and therefore, the use of an informed consent agreement was not necessary. However, every precaution to maintain a high level of integrity and ethical standards while conducting this scientific study was made.

Summary

A quasi-experimental research design was used to determine that the use of CEDs during police and citizen encounters resulted in fewer officer injuries when compared quantitatively to other less-lethal instruments. Data from the Johnson City Police Department, a medium-sized police department located in East Tennessee was analyzed. The data was recorded by police officers on the agencies Suspect Resistant Report and was archived at the Police Property Unit.

Data collected from the Suspect Resistant Reports ranging from January 2005 to December 2014 was properly coded for input into SPSS version 21.0 software for analysis. The dependent variable is officer injury. The independent variable is a

categorically-ranked variable consisting of hands/feet defensive tactics, impact baton, OC spray and CEDs. The categories of the independent variable were placed in rank-ordered based on the physical distance that each less-lethal instrument enables the officer to maintain from the resisting suspect. Cross-tabulation, chi-square and odds ratio were used to analyze the data using the appropriate degrees of freedom and significance level and it was determined to reject the null hypothesis in favor of the alternative. This scientific study adhered to all necessary protocols regarding ethical research applied during research procedures and writing, which was exemplified in a detailed results section in Chapter 4.

Chapter 4: Results

Introduction

The purpose of this quasi-experimental study was to examine whether the use of less-lethal instruments, such as conducted energy devices, oleoresin capsicum, impact batons, and hands/feet defensive tactics reduced injuries to officer at a medium-sized police department in a southern state. Suspect Resistant Reports provided data on the use of less-lethal instruments and injuries sustained by officers during encounters with combative suspects. The analysis used four categorical variables comprised of the less-lethal instruments studied. However considering the number of impact baton deployments (n = 3) during the data collection period, further analysis was conducted with the impact baton combined with the category of hands/feet defensive tactics.

Answering the research question driving this study, the findings from the data analysis found the use of the CED resulted in fewer officer injuries than the use of other less-lethal instruments. Along with addressing the research question, the following hypotheses were tested and subsequently, the null hypothesis was rejected in favor of the alternative hypothesis.

H_o: There will be no significant difference in reported police officer injuries when police use CEDs on combative suspects than when police use other less-lethal instruments.

H_a: There will be a significant difference in reported police officer injuries when police use CEDs on combative suspects than when police use other less-lethal instruments.

The frequency analysis in Table 2 was provided to show statistically the use of multiple less-lethal instruments. These reports were excluded from the analysis, since there would be no possible way to distinguish which instrument resulted in the officer's injury. Other reports were excluded because they documented deadly force with firearms, use of a vehicle as force, and K-9 deployments.

The significance for statistical assumptions and analyses was evaluated at an alpha level of .05, which is widely accepted for scientific research. Of the 504 samples collected from the Police Department (from January 01, 2005 to December 31, 2014), 95 were excluded from the analysis because they included multiple uses of less-lethal instruments during a single incident. This chapter defines the results of the statistical analysis using SPSS.

Data Collection

Ten years of data for this research was requested and collected from the Johnson City Police Department, a medium-sized police department. Permission to collect the data was granted by the Police Chief. The data were extracted from hard copy Suspect Resistant Reports and were reviewed strictly at the Police Department. The reports were not photocopied and no identifying information about officers, suspects or witnesses was collected.

The Suspect Resistant Reports were provided to the researcher in volumes separated and labeled by year and further separated by each month of the year. This aided in the data collection process, however redundant checks for accuracy were conducted throughout the data collection period. Table 1 presents the frequency and percentages of

use-of-force incidents extracted from the Suspect Resistant Reports. Displayed in Table 1, are the most deployments of less-lethal instruments during one year *(n* = 69). These occurred during 2006 accounting for 13.7% of the total 10-year period studied. The lowest reported uses of less-lethal instruments *(n* = 29) occurred during 2014. This table is beneficial to provide information regarding trends in use of force, training issues and for future policy analysis.

Table 1

Frequency %ages of Suspect Resistant Reports Analyzed

Year	Frequency	%	Valid Percent	Cumulative %
2005	58	11.5	11.5	11.5
2006	69	13.7	13.7	25.2
2007	54	10.7	10.7	35.9
2008	56	11.1	11.1	47.0
2009	46	9.1	9.1	56.2
2010	47	9.3	9.3	65.5
2011	52	10.3	10.3	75.8
2012	50	9.9	9.9	85.7
2013	43	8.5	8.5	94.2
2014	29	5.8	5.8	100.0
Total	504	100	100	

From the Suspect Resistant Reports reviewed, the statistical models were created with the following outcome measure: Police officer injury was a dichotomous yes/no variable indicated that an officer had engaged in a police and citizen encounter and deployed one or more of the following less-lethal instruments: hands and feet defensive tactics, impact baton, OC spray and/or CED. The following values were assigned to each less-lethal instrument as they were ranked based on the physical distance between the officer and suspect, thus creating an ordinal independent variable:

1. Hands and feet defensive tactics

2. Impact baton
3. OC spray
4. CED

In order to understand the impact of the less-lethal instruments examined in this study and accurately account for all police and citizen encounters where force was used, a new category was created for each combination use of multiple less-lethal instruments. Those samples were appropriately coded for the independent variable, however cases of multiple less-lethal use were not included in the analysis providing results for this research. The coding for the combinations utilized the above coding protocols, for example if an officer first used hands-and-feet defensive tactics and subsequently used OC spray, that combination was coded 13 and so on. The frequencies and %ages providing how many deployments there was of each less-lethal instrument as well as the combinations of the deployments are detailed in Table 2 below.

It was important to provide the various combinations; however, as stated, the combination uses of the less-lethal instruments were not included in the cross-tabulation or chi-square analysis providing results to either reject or accept the hypothesis or answer the research question. In the 504 reports, 19% (N = 95) were categorized as "combination cases" (see Table 2). The need for future research regarding the use of multiple less-lethal instruments is essential to the study of law enforcement use of force and is further discussed in Chapter 5.

Table 2.

Frequencies and Percentages of all Less-Lethal Instruments Deployed including Combination Uses

	Frequency	Percent	Valid Percent	Cumulative Percent
1	135	26.8	26.8	26.8
2	3	.6	.6	27.4
3	101	20.0	20.0	47.4
4	170	33.7	33.7	81.2
12	3	.6	.6	81.7
13	37	7.3	7.3	89.1
14	32	6.3	6.3	95.4
23	2	.4	.4	95.8
24	2	.4	.4	96.2
34	7	1.4	1.4	97.6
41	1	.2	.2	97.8
42	1	.2	.2	98.0
43	1	.2	.2	98.2
132	1	.2	.2	98.4
134	7	1.4	1.4	99.8
234	1	.2	.2	100.0
Total	504	100.0	100.	

Results

The null hypothesis to be tested was: There will be no significant difference in reported police officer injuries between the use CEDs on combative suspects and the use other less-lethal instruments. As both the independent and dependent variables were measured nominally, cross-tabulation and chi-square were used to detect significant differences and cramer's V was used to measure the strength of any significant associations. Additionally, the odds ratio and relative risk was calculated for significant differences. Officer injury rates in the cross-tabulation calculation were compared across the categories in the independent variable. The cross-tabulation revealed a relationship between police officer injury and less-lethal instruments presented in Table 3.

Table 3 shows the cross-tabulation analysis of the less-lethal instruments (numbered 1- defensive tactics, 2 – impact baton, 3 – OC spray and 4 – CED). The impact baton was so rarely used (n = 3) that it resulted in 3 and 0 in two cells, which violates one of the statistical assumptions of cross-tabulation and chi-square test: No expected frequency should be less than 1 and no more than 20% of the expected frequencies should be less than 5. This was corrected by combining the data of the impact baton and defensive tactics and conducting an additional cross-tabulation analysis displayed in Table 4.

Table 3. *Cross-Tabulation Results of Reported Police Officer injury and Less-Lethal Instrument4*

	Less-Lethal Instruments				
	Hands/Feet Defensive Tactics	Impact Baton	OC Spray	CED	Total
Received No Injuries	99 73.3%	3 100.0%	97 96.9%	167 98.2%	366 89.5%
Received Injuries	36 26.7%	0 .0%	4 4.0%	3 1.8%	43 10.5%
Total	135 100.0%	3 100.0%	101 100.0%	170 100.0%	409 100.0%

$\chi^2(4, N = 409) = 56.234, P = .000$

Considering the number of deployments of each less-lethal instrument, the CED (n = 170) was deployed the most while resulting in the fewest number (1.8%) of officer injuries. The use of OC spray resulted in a higher %age of police officer injury with fewer deployments than the CED. There were no injuries reported when the impact baton was deployed, however given the impact baton was rarely deployed (n = 3), the data was not sufficient to accurately analyze, but is an important statistic for future research.

Consistent with the research on less-lethal instruments, the use of hands/feet defensive tactics resulted in the most officer injury (26.7%) with the second most deployments during the study period. The chi-square statistic concluded that the variables are dependent in the population and there is a statistical relationship between the categorical variables.

Table 4. *Cross-Tabulation Results with Impact Baton combined with Hands/Feet Defensive Tactics*

	Less-Lethal Instruments			
	Hands/Feet and Impact Baton	OC Spray	CED	Total
Received No Injuries	102 73.9%	97 96.0%	167 98.2%	366 89.5%
Received Injuries	36 26.1%	4 4.0%	3 1.8%	43 10.5%
Total	138 100.0%	101 100.0%	170 100.0%	409 100.0%

$\chi^2(3, N = 409) = 54.016, P = .000$

Of the three groups of instruments studied, hands and feet defensive tactics/impact baton were associated with the highest level of injuries (26.1%), which was 6.5 times higher than the number of injuries associated with OC spray (4%) and was 14 times higher than the injuries associated with the use of CEDs (1.8%). Injuries associated with defensive tactics/impact baton were twice the amount as with the CED. In other words, the distance between the officer and the likelihood of officer injury are negatively related. The difference is statistically significant: $\chi^2(3, N = 409) = 54.016, P = .000$; the null hypothesis was rejected.

Table 5. *Cramer's V*

	Value	Approx. Sig.
Nominal by Nominal Phi	.363	.000
Cramer's V	.363	.000
N of Valid Cases	409	

Cramer's V was performed to observe the effect size of the distance on the likelihood of officer injury. As indicated by Table 5, the effect was moderately strong (Cramer's V = .363). Officers were injured making the arrest without the use of the CED in 18.4% of the incidents. The odds ratio, (See Table 6) displays the two by two contingency table used. This required collapsing cells within the variables labeled police officer injuries (1); police officer not injured (0) and CED deployed.

Table 6. *Odds Ratio/Risk Estimate*

		95% Confidence Interval	
	Value	Lower	Upper
Odds Ratio for CED Deployment	.079	.024	.259
Police Officer Injured 1	.830	.783	.881
Police Officer Not Injured 0	10.449	3.315	32.938
N of Valid Cases	452		

While the odds ratio was only .079, the relative risk of injury by not using a CED was 10.45. In other words, officers were more than ten times as likely to be injured not using a CED when handling a combative suspect. The null hypothesis was rejected in favor of the alternative hypothesis: There is a significant difference in reported police officer injuries between the use of CEDs on combative suspects and the use of other less-lethal instruments.

The results of this study are not based on speculation, influenced by the results of previous studies and are completely unbiased. The research was based on deductive forms of logic and theories where numerical codes are applied for the purpose of yielding statistical analysis and the statistical analysis used was properly applied to the data. Statistical findings from this study present evidence to confidently state that the use of CEDs resulted in fewer officer injuries than the use of other less-lethal instruments when handling un-cooperative suspects. Due to a low rate of reported officer injuries, such analysis requires very large samples in order to obtain sufficient number of injuries for comparison. In light of this reason, larger police departments may increase the sample size of reports and, as a result, the number of injuries for better comparison.

Summary

This chapter detailed the examination of the hypothesis and results of this study. Tables were presented providing the statistical analysis conducted to answer the research question. During data collection, all Suspect Resistant Reports (n = 504) ranging in dates January 01, 2005 to December 31, 2014 were collected and reviewed. It was discovered that several Suspect Resistant Reports (n = 95) documented the use of multiple less-lethal instruments. Those reports were included in only the frequencies distribution, providing insight into the full sample size. However, the reports documenting the use of multiple instruments were excluded from the cross-tabulation and chi-square analysis that provided results for this research.

The cross-tabulation showed relationship between less-lethal instruments and police officer injury. The initial chi-square value was significant $\chi^2(4, N = 409) = 56.234$,

P = .000. The cramer's V indicates moderately strong effect that the variance in instruments on the likelihood of officer injury, while the odds ratio was .079, the relative risk of injury of not using the CED was 10.45%. Additional analysis was conducted after the impact baton was collapsed into the category of hands/feet defensive tactics. The results of this analysis $\chi^2(3, N = 409) = 54.016$, P = .000 did not impact the decision to reject the null hypothesis in support of the alternative. Further discussion of the results will be presented in Chapter 5 along with recommendations and findings.

Chapter 5: Discussion, Conclusions, and Recommendations

Introduction

The purpose of this quasi-experimental study was to examine whether the use of less-lethal instruments, such as conducted energy devices, oleoresin capsicum, impact batons, and hands/feet defensive tactics reduced injuries to officer at a medium-sized police department in a southern state. This study examined police officer injury through a quantitative analysis that compared CEDs to other less-lethal instruments, including hands and feet defensive tactics, the impact baton, and OC spray.

This research project addressed the relationship between the type of weaponry used and the likelihood of officer injury during physical encounters between police and suspects. The research for this study proposed to examine injuries associated when four types of less-lethal instruments were deployed in a police-civilian encounter. However, the impact baton was singularly deployed in only three encounters of the 409 samples examined for this study. With the lack of data for the impact baton, the categories of defensive tactics and the impact baton was combined since both less-lethal instruments place the officer in relative close proximity to the suspect.

This study has presented empirical evidence that CEDs deployed by officers when suspects are physically combative resulted in fewer reported police officer injuries (police officers received injures when using CEDs only 3 out of 170 deployments). Consistent with previous research, police officers continue to use hands and feet defensive tactics as an initial response. This study found that when officers deployed defensive tactics during 135 incidents, they received the highest number of injuries of the

instruments studied, while the CED yielded the least amount of injuries with the most deployments. This intelligence is essential for law enforcement leadership tasked with the responsibility of developing and implementing policy on the use of less-lethal instruments.

Police officers are permitted to use various types of less-lethal technology and are trained on when and how the force can be applied. However, use of force issues continues to be one of the most important and challenging issues for law enforcement management (Taylor, Woods, et al., 2009). Second to reducing the use of force is reducing the number of injuries to anyone involved in a police–suspect encounter. The reduction of injuries in law enforcement encounters has been studied through research as well as through practical application. However, there are no less-lethal instruments that can guarantee that police officers will not be injured when faced with combative suspects.

This study has provided results reflecting the effectiveness of CEDs in reducing police officer injury during police and citizen encounters. Statistical evidence also showed that OC spray was more effective than hands and feet defensive tactics as well as the impact baton. The results displayed the effectiveness of less-lethal instruments to reduce reported police officer injury from a proximity perspective. No previous studies have related police use of less-lethal instruments to officer injury from the perspective of proximity as this study has. Therefore, the findings from this study provide new and valuable insight into the use of less-lethal technology and police officer injury as well as to the literature on police use of less-lethal force.

Medium-sized police agencies differ from larger metropolitan police departments in that smaller agencies experience fewer calls-to-service and average fewer incidents where force is used. Paoline III, Terrill and Ingram (2012) used more than 12,000 reported use of force incidents to analyze police injury comparing CEDs to hands and other weapon-based tactics. The findings showed fewer officer injuries when the CED was deployed. However, the researchers did not uniquely classify the less-lethal instruments into defining categories as this study did by ranking the instruments by order of proximity.

Similar to the research in this study, Terrill, Leinfelt and Kwak (2007) examined the use of CEDs, OC spray, impact baton and empty hand defensive tactics. As with previous research including this study, it was found that the use of the CED has gained popularity in law enforcement to the point of possibly replacing the impact baton an eventually replacing OC spray as well. However, police officers continue to use defensive tactics as a means of subduing combative suspects in spite of the overwhelming statistics that show an association between police officer injuries and the use of hands and feet defensive tactics. The researchers did not elevate or further define the less-lethal instruments to better understand why police officer injuries were reduced when the CED was deployed as the current study did.

Interpretation of the Findings

As police officers continue to receive injuries when addressing combative suspects, this study set out to find if the use of CEDs resulted in less reported police officer injures than other less-lethal instruments. The use of Suspect Resistant Reports over a ten-year period

(2005 – 2014, $n = 409$) contributed uniquely to the empirical literature already available regarding CED effectiveness. Answering the research question, this study concluded that the use of CEDs was associated with fewer reported police officer injuries compared to other less-lethal instruments including hands and feet defensive tactics, impact baton and OC spray at one medium-sized police department.

Based on the statistical results presented in Chapter 4, the null hypothesis was rejected. The findings showed significantly less reported police officer injuries when police use CEDs on combative suspects than when police use other less-lethal instruments. The study gained a deeper understanding of the dynamics in combative situations between police and suspects. It was evident that police officers were less likely to be injured when they were able to resolve a combative situation from a greater distance. The contrast was especially significant between the use of the CED and deployment of hands-and-feet tactics, as the CED allows for the most distance and defensive tactics allow for no distance from the suspect.

Most police and civilian encounters place all involved parties at a close proximity often making physical contact unavoidable; as a result, hands-and-feet defensive tactics continue to be used and are associated with higher rates of police officer injuries. As the use of the CED allows for much safer distance between the encountered parties, officer injury is likely to be significantly reduced.

Previous studies have used similar approaches to analyzing police officer injuries with many studies also examining the injuries of the suspect. Several of these studies used secondary data in the form of use-of-force reports as this study did. White and

Ready (2010) found that the use of the CED by police officers did create distance between the officer and suspect while measuring the effectiveness/ineffectiveness of CEDs based on the level of suspect resistance. This study could not conclusively state the effectiveness of the CED since the study was determining the level of resistance according to the time it took to incapacitate the suspect. The researchers struggled with accuracy issues regarding time recorded on the reports. Unlike the current study, where no reporting discrepancies were found.

In a large multi-agency study conducted by Smith, Kaminski, Alpert, Fridell, MacDonald and Kubu (2010), police and suspect injuries were analyzed. None of the agencies studied had trained and issued CEDs to all the department's officers. The study found that most officer injuries were associated with the use of defensive tactics and not the CED, however the study was not focused on police or suspect injury, but rather aimed at identifying individual and situational predictors of injuries to officers and citizens as well as the likelihood of injury. This study used three law enforcement agencies (Richlands County, Seattle Police and Miami-Dade) with various findings regarding less-lethal instruments warranting further research such as the research the current study provided.

Contributions to the literature on police officer injury and the CED have been through various comparative studies of agencies using CEDs to agencies that have not incorporated the CED into their arsenal. Taylor et al. (2009) studied a total of 13 police departments, of which, seven had issued CEDs and six that had not yet adopted them. The study analyzed a variety of variables including police officer injury and consistent

with this study, the agencies employing the CEDs found officers are over 70% less likely to be injured than the officers at the agencies not using CEDs; showing a 76% reduction in officer injuries. This study provided statistical findings on CED use, but did not compare the CED to other less-lethal instruments. These findings speak largely to agency trends and not to the officer's use of CEDs.

Police use of force in relation to proximity is not an unexplored concept. according to Vilk and Chan (2007), During the 1990's, the widespread adoption of OC spray was done so that police officers may effectively handle a combative suspect 10 to 12 feet away (Vilk & Chan, 2007). Similar to this study, presented the concept of distance between the officer and suspect was studied, but previous research was not as specific as the present study, which uniquely used a cross-sectional study observing differences associated with each less-lethal instrument.

Alpert and Dunham (2010) found that the odds of police officers getting injured greatly increased when the officer and suspect are within arms-reach, but did not define the distance by the instrument used. It was also found that when police officer's use defensive tactics and compliance holds, they are more likely to be injured than when they are able to resolve the situation without physical engagement (Crow & Adrion, 2011). In spite of these findings, the frequency distributions shown in Table 1 and a variety of studies supporting police officer injury and proximity to the suspect show that police officers routinely use defensive tactics as an initial response to a combative suspect instead of other less-lethal instruments providing greater distance.

The foundational framework for this study was crafted from the concept of democratic policing, which theoretically provides the foundation for policy direction as well as the force continuum guiding police use of force. The growing use of the CED as well as the results of this study aligns with the prime objective of law enforcement to use only the force necessary to resolve a combative situation.

This study found that police officers at the JCPD deployed the CED during 170 encounters with a combative suspect and received injuries in only 3 (1.8%) incidents. This statistic contributes to effective resolution through the use of a temporary incapacitating device, which is essential for law enforcement and the application of the least amount of force necessary. This use-of-force philosophy will continue to be expanded upon through future research as well as through technology development.

This study focused on singular uses of less-lethal instruments in an effort to find which instrument resulted in fewer police officer injuries. However, it was discovered that during a relatively high number of samples (19%) that multiple less-lethal instruments were used. The use of multiple less-lethal instruments warrants further research regarding police training, understanding why officers use more than one less-lethal instrument, as well as the results of those encounters. This finding reflects the current complexity of law enforcement and the use of force, raising questions regarding situational changes between the officer and suspect. Therefore research directed at these encounters are both valid and important.

The impact baton has been part of the law enforcement less-lethal arsenal for many years and based on the findings of this study, future research should address

whether the impact baton is still a relevant less-lethal instrument or obsolete and no longer needed. The Police Department reported deploying the impact baton during only three police and citizen encounters over a ten-year period. Compared to the other less-lethal instruments, even the use of hands/feet defensive tactics where more police officers are injured, the impact baton was consistently not used. With most law enforcement agencies concerned with use-of-force, research addressing policy, training and issuance of a less-lethal instrument that is not being deployed is warranted and needed.

Limitations of the Study

As this study advances the use of less-lethal instruments in law enforcement, the results should be interpreted with several limitations in mind. Conducting use-of-force research presents unique challenges and barriers such as inaccurate documentation, missing data and the lack of standardized use-of-force reporting (Taylor & Woods, 2010). This study was not plagued with issues surrounding irregularities pertaining to the issuance of all less-lethal instruments to the officers. However, this study used secondary data collected from a ten year period. There is always an inherit risk when using documented reports that the reports were inaccurately recorded either intentionally or unintentionally. In regards to this research limitation, future research should use additional data sources such as interviews or observations as a means to verify the authenticity of the reports.

This study serves as an informative research document focused on the use of less-lethal instruments for medium-sized law enforcement agencies. It may be inappropriate to draw conclusions and generalizations to other law enforcement agencies since only one

medium-sized police department provided data analyzed for this study. It is therefore recommended that future studies gather and analyze data from multiple police departments similar in demographics and police population so that the findings may be generalized to a broader population.

Recommendations

It is evident that in many studies focused on CEDs that the CED has emerged as the most popular less-lethal instrument issued in law enforcement. And with such popularity growth as with this less-lethal instrument, there is also a likelihood of abuse or misuse of the CED. When police officers are quick to deploy CEDs and rely too heavily on CEDs to mitigate situations, interpersonal and communication skills routinely used by police to resolve conflict become displaced and ignored (Alpert & Dunham, 2010). With these points identified through this study, it is recommended that future research steer in the direction of conflict resolution and training surrounding threat assessment by law enforcement officers.

To provide a deeper understanding of the impact of less-lethal instruments and police officer injury, it is also recommended that research be conducted regarding the severity of the injury as well as examining contributing factors displayed by the suspect. Previous literature suggests that most suspects engaging in violent and combative behavior toward law enforcement are under the influence of alcohol, or narcotics, and warrants future research for police training and preparation to effectively handle those situations.

During data collection, it was discovered that of the 504 samples, 95 of those samples involved the use of multiple less-lethal instruments. Those samples were excluded from the analysis since injury to officers cannot be conclusively attributed to a single less-lethal instrument. Expanding on this study and to better understand police officer injury and less-lethal instruments, it is recommended that future research focusing on the use of multiple less-lethal instruments and police officer injury be conducted.

Historically, the impact baton was the alternative to police officers using deadly force and was widely received and adopted by law enforcement agencies prior to the onset of OC spray or the CED. According to previous research as well as this study, it is important to note the use of the impact baton has greatly diminished and has been surpassed by other technologies in the less-lethal categories. Based on the findings of this study regarding the limited use of the impact baton, it is recommended that future research regarding the effectiveness of the impact baton in law enforcement be initiated and pursued.

Policy review and/or change as well as a review of the force continuum maybe warranted based on the findings of this study. Since there is no uniform force continuum and each law enforcement agency operates within its own protocols on use-of-force policy, the review and/or change should be at the discretion of each law enforcement agency based upon their unique available resources and needs. It is imperative that law enforcement agencies stay informed on the topics of less-lethal technology through reviewing current research, such as this study, providing direction for use-of-force policies and force continuum development.

Implications for Positive Social Change

The findings presented in this study are a result of the attention, training and responsibility the Johnson City Police Department has applied to the development and adherence to the application of less-lethal instruments embodied within their use-of-force policy. The JCPD strives to use only the force necessary to apprehend combative suspects. This police department embodies democratic policing as they hold the highest priority of admiration for and the fortification of life, evident through their accountability and transparency.

Public trust and confidence with law enforcement in especially how police officer's handle the use of force have become fragile and in many incidents are completely broken. It is with great care and diligence that law enforcement restore weakened credibility and once again be perceived as a guardian and not a militant. Research such as this study contributes to the literature already compiled on police use of force, police officer injuries and less-lethal technology.

Law enforcement agencies that have achieved a successful conduit with the community in regards to policing and civility have established relationships and communicate law enforcement goals and objectives with the citizens it serves. When citizens have knowledge and are enlightened to the roles and responsibilities of police officers including use of force, they become stakeholders in their community and view law enforcement as a collaborative partner resulting in positive social change.

The use of CEDs and other less-lethal instruments were measured in this study in an effort to evaluate the use of force policy at the Police Department. The results showed

that when police officer's deployed CEDs, which allowed for the greatest amount of distance between the officer and suspect, they were less likely to receive injuries than when they used other less-lethal instruments. This statistic reveals the efforts of law enforcement to reduce police officer injuries and use less-lethal force that temporarily incapacitate suspects.

Conclusion

Managing use of force continues to be a challenge for law enforcement leadership and managers and with new technologies and innovative techniques claiming to reduce injuries, research is essential for validation and preparedness in police work. Critical to law enforcement use-of-force policy is the application of the least amount of force necessary to control a combative suspect (Taylor et al., 2009). This study provides law enforcement leaders and managers responsible for policy development on police use of force with clear, informative research to assist and guide their decisions. Policy on police use of force ultimately impacts the health and safety of citizens, police officers and the community.

While years of research have been conducted about police use of force and especially the use of lethal force, there is much to be learned about the effectiveness of less-lethal instruments. No other research projects have studied police officer injuries from the approach this study did. This study was unique in the analysis of ranked less-lethal instruments according to specific distances the instrument afforded the officer and suspect when the instrument was deployed. Following the statistical analysis, the null hypothesis was rejected finding there were significantly less reported police officer

injuries when the CED was used on combative suspects than when other less-lethal instruments were used.

The widespread adoption of the CED in the law enforcement community has generated new interest in use-of-force research. The results and findings presented in this study are additions to previous research and uniquely contribute to a growing knowledge of the capabilities of less-lethal technology and injury reduction. However, the need for future research surrounding this topic remains and should be critically pursued. The quest for positive social change may be accomplished through use-of-force policy modeled in a humane approach incorporating the components of democratic policing.

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