The BJA/PERF Body Armor National Survey:

Protecting the Nation's Law Enforcement Officers

PHASE II FINAL REPORT TO BJA | AUGUST 9, 2009

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BJA
Bureau of Justice Assistance
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Police Executive Research Forum

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Executive Summary

While the vast majority of law enforcement agencies (99 percent) responding to a recent Police Executive Research Forum (PERF) survey indicated that their officers currently are provided body armor, only about half of these agencies (59 percent) indicated that they *require* their officers to wear body armor at least some of the time. Also, less than half of the agencies that mandate that body armor be worn have a written policy on this issue, making enforcement of the policy more complex. Most agencies do not issue for everyday wear body armor that protects against rifle or armor-piercing bullets, but most agencies at a minimum use body armor that protects officers against 9mm and .40 caliber bullets. Overall, these levels of protection offered to officers have been sufficient against most handgun threats, but not against threats from high caliber weapons or rifles. Also, only a quarter (29 percent) of the agencies surveyed issue supplementary trauma plates to officers for added protection for the most vulnerable part of the body—the torso.

While it is encouraging that almost all agencies do provide fiscal support/resources to ensure their officers wear body armor, the PERF survey found that most agencies do not have stringent fit and maintenance policies. Twelve percent of the departments said their officers are not fitted for body armor, other than receiving a size that approximates their body size. Given the importance of fit to the proper functioning of body armor, as highlighted in the National Institute of Justice (NIJ) body armor standards, this percentage is of some concern. Related to this issue, the vast majority of agencies (90 percent) do not conduct inspections to ensure that officers' body armor fits well and/or is maintained properly. Of the few agencies that do conduct these inspections, most frequently, inspections for fit are conducted only once a year or less (57 percent). Also, the majority of law enforcement agencies surveyed (78 percent) do not have a database or automated record system for a body armor replacement schedule (e.g., replacement of armor every five years) and nearly one-quarter of agencies have no policy concerning replacement of body armor and it's unclear how often they actually replace their armor.

The results above are based on a survey conducted in 2007 with a large, nationally representative sample of law enforcement agencies (n= 782). These results are important because they are the first time a survey representative of the nation's local and state law enforcement agencies was conducted on policies and practices regarding body armor. The basic issue addressed by this survey was whether additional steps could be taken to improve the safety of our nation's law enforcement officers. As outlined in this report, we believe a number of improvements can be made in terms of mandatory body armor wear requirements and more stringent fit/maintenance policies.

The past couple of years have been tumultuous in terms of the vast swing in officer on-duty deaths from record highs in

2007 to the dramatic drop-off in 2008. The media has documented this turbulence. "2007 is turning out to be one of the deadliest years in decades for police," according to the National Law Enforcement Officers Memorial Fund (NLEOMF), with officer deaths by gunshots up 30 percent over the year before, as of December 14, 2007 (see http://www.nleomf.org). "These are staggering numbers," said Craig Floyd, chief executive officer of the group, in an interview with the *Washington Times*.[1] "We haven't seen numbers this high in nearly 30 years. What makes it particularly disturbing is that we've made such great strides in the last three decades in preventing firearms deaths among officers. The statistics are alarming, to say the least." Police officials quoted in the *Washington Times* article and others news accounts collected by NLEOMF say the increase in the fatal shootings of officers is due to the fact that "criminals increasingly have stronger firepower than police—and have no qualms with using it."[2] Palm Beach County, Fla. police spokesman Paul Miller said that "there seems to be a growing propensity for criminals to shoot at officers."[3] Following the October 31, 2007 shooting of a Philadelphia police officer—the city's third shooting of an officer in four days—Mayor John F. Street said "there is a criminal element in this city and around the country that have completely lost any respect for authority, and the proliferation of guns in this city and in cities around the country make this a very tough job for the Police Department."[4] Miami Police Chief John F. Timoney described an emerging "hunter" mentality among criminals, and blamed the increase in officer deaths on "a huge increase in the number of AK-47s on the street."[5] Across the country, law enforcement agencies are acquiring more powerful firearms and ammunition in an effort to keep pace with the increasing lethality of criminals' weapons.[6]

Without notice, in 2008 a complete reversal occurred. Based on NLEOMF data, the number of recorded cases of officers being killed dropped by 23 percent in 2008 (from 181 homicides of officers to 140). The 2007 number of 181 officers killed represented one of the highest totals in two decades. However, the 2008 number of 140 officers killed represented one of the lowest totals in four decades. According to Craig Floyd, chief executive officer of NLEOMF, as cited in the NLEOMF website, "With 181 officers killed last year, 2007 was a wake-up call for law enforcement in America. Now, data suggest that law enforcement executives, officers, associations and trainers heeded that call in 2008—and our nation's peace officers were safer as a result. Heightened awareness of the problem has led to greater emphasis on officer safety training, policies and equipment, all of which contributed to the dramatic reduction in fatalities..." Despite the dramatic downturn there is still much work to be done. Jennifer Thacker, National President, Concerns of Police Survivors (C.O.P.S.) was quoted on the NLEOMF website as saying, "C.O.P.S. is pleased to see the reduction in officer deaths for 2008, but we know that for each of the surviving families and co-workers, their one officer is one too many. These families,

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1 http://www.washingtontimes.com/apps/pbcs.dll/article?AID=/20071119/NATION/111190027/1002/NATION

2 Ibid.

3 Ibid.

4 http://www.philly.com/philly/news/20071031_Alarming_trend__Nationally_and_locally__criminals_aim_at_police.html

5 http://www.usatoday.com/news/nation/2007-10-14-copshoot_N.htm?POE=click-refer

6 http://www.time.com/time/nation/article/0,8599,1666750,00.html

co-workers and agencies are struggling to cope with life without their officer and will need support ...” While many have applauded the dramatic reduction in fatalities, little is still known why the rates of officer deaths dramatically increased in 2007 and what caused the rates to decrease.

The turbulent nature of the policing environment raises concerns about what can be done to improve officer safety. The killing of a law enforcement officer has a terrible impact not only on the officer’s family and friends, but on his or her law enforcement agency and the entire community. In most cases, at the moment an officer is shot, he or she is attempting to hold the line between order and disorder. Thus, the shooting of an officer is a brutal affront to a community’s sense of peace. And the officers’ comrades in the law enforcement agency may feel shaken, as they ask themselves whether everything that can be done to protect them is being done and/or what could we have done better.

Wearing bullet-resistant vests is considered one of the most effective ways for officers to protect themselves against the threat of criminals using a firearm against them. Yet despite the increased use and undeniable benefit of body armor in law enforcement, systematic research and data on law enforcement agencies’ policies and practices regarding body armor and their influence on officer practices and safety outcomes is severely lacking. In order to address this shortcoming, the U.S. Department of Justice (DOJ), Bureau of Justice Assistance (BJA), asked PERF to conduct a national survey exploring local law enforcement agencies’ policies and practices regarding body armor/bullet-resistant vest use.

The development of body armor has its origins in the search by military organizations for ways to protect soldiers during World Wars I and II, and even in crude devices developed during the Civil War and earlier. The 1960s saw the development of bullet-resistant synthetic fibers that would eventually allow for concealable soft armor, but it was not until the 1970s that one of the most significant achievements in the development of body armor occurred: the invention of DuPont’s Kevlar ballistic fabric that would allow for armor suitable for law enforcement use. Ballistic vests are now considered critical to officer safety and are widely used by law enforcement agencies across the country. Body armor currently provides high levels of protection, particularly in hazardous situations that specifically require ballistic protection. Additionally, law enforcement ballistic vest use is now supported by a thriving manufacture and supply industry.

However, there remain ongoing debates regarding whether law enforcement agencies should require officers to wear body armor—especially when warm weather can make it uncomfortable. In addition to policies on promoting or mandating the wearing of vests, other issues include efforts to improve vest standards, and concerns about vest maintenance requirements. Extensive funding and research continues to go into the development of the most lightweight, cost-effective, concealable, and protective product. The issues surrounding body armor, particularly those focusing on standards, were brought to the forefront most recently with the failures of Zylon®-based body armor in 2003. The Department of Justice (DOJ) has continued to promote the development of upgraded standards, as well as to promote the use of body armor by law enforcement agencies, through its Bulletproof Vest Partnership Program.

The purpose of this study is to add to the understanding of body armor policies and practices among U.S. law enforcement agencies. This BJA Body Armor Survey is the second phase of a large-scale project regarding body armor and officer safety. Phase One

was conducted in 2005 by PERF and focused solely on the use of Zylon®-based body armor by the 100 largest law enforcement agencies in the United States. This second study, Phase Two, collected additional data on the use of body armor from a large, nationally representative sample of law enforcement agencies. We designed our research to inform and assist law enforcement in the development of policies and programs to improve the safety of officers across the nation. The BJA Body Armor Survey gathered data from 782 law enforcement agencies across the United States on policies and practices regarding body armor. Specifically, we collected data on policies regarding the wearing of body armor, whether officers are provided with armor or must purchase it themselves, the types of body armor used, fitting and maintenance of armor, as well as data on outcomes of use and officer safety.

The results of the survey revealed that officers across the country wear body armor when on duty, and while it is not a requirement of most agencies, almost all agencies do provide resources to ensure their officers wear body armor. As a result of these policies, officers are more likely to be wearing body armor while assaulted in the line of duty, and the number of officer deaths is lower than it otherwise would be. On the other hand, while most agencies do encourage the wearing of body armor, most do not have stringent fit and maintenance policies. And in fact, agencies' maintenance of body armor is limited, and most do not conduct inspections of armor to ensure proper fit and maintenance.

Given the turbulent nature of the policing environment and dramatic variation over the past couple of years in the number of officers killed in the line of duty, there may soon be a need for a nationwide effort to encourage agencies to revisit their body armor wear policies to increase their comprehensiveness and stringency.

Introduction

While the use of body armor in law enforcement is both widespread and clearly recognized as critical to officer safety, very little independent research data has been collected about agency-wide policies and practices regarding body armor.[7] Furthermore, there is very little systematic data about the types of body armor that police agencies typically use, how officers are fitted for body armor, officers' and agencies' maintenance practices to care for their body armor, and how these practices impact officer safety. Below is a review of the existing literature on the following topics: the historical development of body armor; the benefits of body armor use for officers; and the research that has been done on body armor use and practices by law enforcement agencies nationwide.

7 Body armor is sometimes referred to as a "bulletproof vest." However, such terminology is not entirely accurate. Bullets of certain sizes and composition, fired at sufficient velocity, may be able to penetrate body armor, depending on the stitching, weave and thickness of the armor. Bullets do not bounce off armor; rather, the layers spread the impact over a greater area of the body, dispersing the round of penetrating power. In addition to the layering of the fabric, the weave and stitching play a significant role in transferring impact across the entire protective panel. Armor can also deform a bullet's shape, which further contributes to making the round less likely to penetrate the tough layers.

Review of Relevant Literature

Historical Development of Body Armor: Use, Policies, and Practices in Law Enforcement

This section explores the development of body armor from the earliest forms, to the various military developments—particularly through the world wars, the Korean and Vietnam conflicts—to the discovery of synthetic fibers that led to the modern iteration of body armor and the developments and testing that led to the armor standards in existence today.

Earliest forms of body armor

Throughout history, humans have used an ever-advancing range of clothing and materials to protect themselves from injury during combat or other hazardous situations. Recorded history provides many examples of such advancements in personal protection technology, including the use of animal skins, leather vests, wooden shields, metal shields, helmets, and chain-mail vests. With the advent of the firearm (c.1200 A.D.), however, these types of protection were rendered ineffective (Chase, 2003). At that time, the only real protections against firearms were man-made barriers, such as stone or masonry walls, or natural barriers, such as rocks and ditches.

The U.S. military interest in "bulletproof vests" was initially very limited. The first bulletproof vests—in the form of protective shields and breastplates—were used by Union soldiers during the Civil War. However, they were not military-issued, but rather were developed by independent parties and bought from peddlers (www.Globalsecurity.org). These forms of protection consisted of cast iron plates; because they were extremely heavy, their use was eventually discontinued.

One of the first recorded instances of the use of soft armor was by the medieval Japanese, who used armor manufactured from silk (National Institute of Justice, 2001). It was not until the late 19th century that the first use of soft body armor in the United States was recorded (National Institute of Justice, 2001). At that time the military began exploring body armor use and specifically the possibility of using soft armor silk. However, these garments tended to be effective only against low-velocity bullets and did not offer much protection against the new generation of handgun ammunition being introduced at that time (National Institute of Justice, 2001). Various forms of protective devices were developed by the U.S. military and were first used in combat in World War I, but their weight severely restricted their use. The British focused on developing nonmetallic ballistic material for protection, but these turned out to be very costly and difficult to produce (National Institute of Justice, 2001).

Historical information is also available from the U.S. Patent and Trademark Office, which has records dating back to 1919 for various designs of bullet-resistant garments. Here, one of the first documented uses by officers was in 1932 by the D.C. Metropolitan

Police.[8] Overall, however, none of these designs proved entirely effective or feasible for law enforcement use (U.S. Department of Justice, 2001).

Military developments of body armor

The next generation of ballistic vests was researched and issued by the U.S. military during World War II. Constructed of ballistic nylon with steel plates sewn into cloth and commonly known as the "flak jacket," these vests provided protection primarily from munitions fragments, as opposed to bullets (U.S. Department of Justice, 2001). They were issued to the Army CORPS in 1942. These vests had been adapted from vests developed by the British Royal Air Force (www. Globalsecurity.org). While these vests were helpful to air crews in reducing injuries during World War II, the U.S. military continued investigation into the development of armor for ground troops. Most were too heavy and restrictive. The military continued to work on the development of new vests, for example, the Doron fibrous glass fabric and the M12 nylon and aluminum vest (www.globalsecurity.org). The Korean War saw vests reintroduced to troops in the field, using both the aluminum plate vests and newer all-nylon vests. Research continued during the Vietnam War to make flak jackets lighter (www.globalsecurity.org).

Modern body armor

In the late 1960s, new fibers were discovered that made today's modern generation of concealable body armor possible. New materials that could be woven into lightweight fabric were identified, allowing for significant achievements in body armor, the most notable of which was DuPont's Kevlar® ballistic fabric. Kevlar® was originally developed for use in radial tires, and was adapted for body armor by packing fibrous layers together. The material worked by deforming the bullet and spreading its energy as it hit the body armor.

With a doubling of officer deaths in the mid-1960s to early 1970s, the National Institute of Law Enforcement and Criminal Justice (the predecessor of the National Institute of Justice) responded with a research program to explore the development of lightweight body armor for daily use by officers (Justice Technology Information Network, 2005; www.globalsecurity.org). At the same time, the National Bureau of Standards (now known as the National Institute of Standards and Technology) developed performance standards defining the requirements for police ballistic-resistant body armor. The U.S. Army's Edgewood Arsenal, Aberdeen Proving Grounds, and Natick Laboratories were also significant contributors to the development of body armor during this time. The period from 1971 to 1976 saw a large and highly specialized team effort by private entities and government agencies in this body armor research and development program.

Ongoing testing of body armor lasted several years throughout the early 1970s, with complex testing procedures to ensure protection against the most common types of bullets faced by officers (.38 special, .22 long rifle, as well as 9mm, .45 and .32 caliber) (www.globalsecurity.org). The Army's Edgewood Arsenal researchers also tested environmental factors that could potentially affect vest performance and degradation, such as sunlight and detergents (NIJ, 2001).

8 The Chicago City Council minutes from 1899 show a record of an ordinance considered in 1899 that directed the city to purchase several "bullet proof garments" for every police station in the city's Police Department.

Extensive and complex medical testing on animals, cadavers, and clay/gelatin also was conducted, to determine the possible effects on the body when a bullet is stopped by the armor (NIJ, 2001). Early in the development of body armor, researchers found that even if a round does not penetrate the vest and hit flesh, it could still kill by causing blunt-force trauma. One study determined that 44 millimeters was the depth of blunt force trauma a human body could sustain without fatality.

Final testing in 1975, with a release of more than 5,000 garments to 15 urban police departments, involved monitoring the wearability of body armor, the degree of comfort and mobility over long wear, psychological effects, and overall effectiveness (NIJ, 2001). The first documented instance of this release of vests saving a officer's life occurred in 1975, when a Seattle police officer who was shot over the heart was saved by Kevlar® body armor.[9] There were 18 subsequent incidents that successfully protected officers in the one-year demonstration period of the vest (NIJ, 2001).

The early Kevlar® body armor was bulky and heavy. Since then, extensive funding, research, and development have been expended on developing a product that is cost-effective, lightweight, suitable for daily use, concealable, and, most importantly, effective. Over the past 25 years, the use of body armor has become commonplace in law enforcement. The National Law Enforcement and Corrections Technology Center has seen a sharp increase in submissions of new body armor models by manufacturers worldwide. Likewise, NIJ's standard for body armor has become the benchmark for effectiveness in body armor worldwide. Additionally, developments in body armor have led to specific models that are puncture—and stab-resistant. In 1994, the U.S. Department of Justice and U.S. Department of Defense entered into a cooperative agreement to develop technologies jointly in recognition of the fact that the military and law enforcement often perform similar functions. This history of collaboration, formalized through the 1994 agreement, goes back to the 1960s development of body armor technology as mentioned previously. This new joint technology program aims for the ongoing improvement in personal body armor. This program managed the development of vests with titanium or ceramic inserts that provide both handgun and rifle protection and are concealable and relatively lightweight. The insert areas of these vests offer protection against armor piercing bullets, as well.

To date there are more than 80 body armor manufacturers that have chosen to participate in the NIJ's voluntary compliance testing program (Tompkins, 2006). One of the most common bullet resistant fabrics is DuPont's Kevlar® fiber (Kevlar 29). DuPont has since released several additional generations of materials with increased protection. Other common names in ballistic-resistant materials are Honeywell's Spectra®, Twaron Product's Twaron®, and Toyobo's Zylon® (Justice Technology Information Network, 2005).

Body armor technology continues to change and improve. For instance, manufacturers once used almost exclusively a single type of fiber in constructing concealable body armor (U.S. Department of Justice, 2001). Today, at least five different types of fiber are used to manufacture ballistic-resistant

9 The first recorded instance of a vest saving an U.S. law enforcement officer's life was that of a Detroit police officer in 1973 who was wearing a concealable ballistic vest (NIJ, 2001).

fabric, each of which is available in a variety of woven and nonwoven fabrics and panels (U.S. Department of Justice, 2001). The ballistic protection properties differ among materials, and often two or more types of fabrics or composites are used in combination to manufacture a vest (U.S. Department of Justice, 2001).

Technological advances in body armor now offer various levels of protection against the range of ballistic threats. In addition, newer models can be worn as a concealable undergarment or can be incorporated into a uniform shirt, vest, coat, or other type of outer garment. These newer models can also be worn over a uniform (such as armor worn by special tactical teams). These same models provide a range of coverage (e.g., some armor panels cover the front and back of the torso, while others also wrap around the sides). Further, ballistic panels can be removed from the carrier on some models so the carrier can be washed (U.S. Department of Justice, 2001). Vests that are concealable have become more important in policing with the increased focus on police and community interaction, while maintaining officer safety. Concealable vests allow officers to appear more approachable and blend in as opposed to outer-wear vests which appear more militaristic and can often add a level of intimidation to the appearance of police. As policing moves away from the more militaristic approaches to community policing styles, appearance and approachability becomes more important—this includes the use of concealable body armor.

Body Armor Current Ratings and Standards

To aid the law enforcement community, NIJ (2001) developed a rating system for body armor according to its protection power in terms of bullet types, bullet mass, and minimum velocity impact (see table below). In September 2000, NIJ released NIJ Standard 0101.04—the first revision after 13 years, which took into account the new threats faced by officers (for example, automatic weapons as opposed to revolvers) and new manufacturing and design capabilities. Standard 0101.04 establishes six formal armor classification types (Types I, II-A, II, III-A, III, and IV). The standards ensure that each armor type will provide a clearly defined minimum level of protection. This includes requirements on the quality of workmanship, maximum allowable deformation of clay backing material during testing, adequate protection when exposed to moisture, and resistance to penetration of angle shots (NIJ, 2001).

Exhibit 1 below provides a summary of the NIJ rating for each of six body armor types (NIJ, 2001).[10] In short, Types I, II-A, II, and III-A armor are required to prevent penetration from the impact of six bullets at specified velocities and locations for two types of ammunition. For two of the impacts in each six-shot sequence, the vest must be able to withstand a shot at a 30-degree angle. Type III armor requirements are identical to those above, except that only one type of ammunition is specified, and all six test rounds are fired perpendicular to the surface of the armor. Type IV armor is also required to thwart penetration from ammunition that is designed to pierce armor.

10 The 2001 rating system was used for the purposes of our study. However, recently NIJ issued a new set of standards (*Ballistic Resistance of Body Armor, NIJ Standard-0101.06,* July 2008). Personal body armor covered by this new 2008 standard classifies body armor into five (instead of six) types (II-A, II, III-A, III, IV) by level of ballistic performance.

Exhibit 1. NIJ ratings of body armor

Armor type	Bullet	Bullet weight	Minimum velocity	Description
Type I	.22 long rifle lead round nose (LRL RN) .380 ACP full metal jacketed round nose (FMJ RN)	2.6g 6.2g	1080 ft/s 1055 ft/s	Light, minimal level required for all on-duty officers
Type II-A	9mm FMJ RN) .40 S&W caliber FMJ Protects against Type I threats	8.0g 11.7g	1120 ft/s 1055 ft/s	Suited for full-time use by law enforcement
Type II	9mm FMJ RN .357 Magnum jacketed soft point (JSP) Protects against Type I and Type II-A threats	8.0g 10.2g	1175 ft/s 1400 ft/s	For full-time wear; heavier and more bulky
Type III-A	9mm FMJ RN .44 Magnum Jacketed hollow point (JHP) Protects against most handgun threats, Type I, II-A and II threats	8.0g 15.6g	1400 ft/s 1400 ft/s	Highest level of protection available for concealable wear. Suitable for routine wear; however, hot-weather climates affect comfort level
Type III (rifles)	7.62mm FMJ (military designation M80) Protects against Type I through III-A threats	9.6g	2750 ft/s	Intended for tactical situations, e.g., barricade confrontations
Type IV (armor piercing rifles)	.30 caliber armor piercing (AP) bullets (Military designation M2 AP) Provides single hit protection against Type I through III threats	10.8g	2850 ft/s	Highest level of protection currently available; for use in tactical situations

Critical Issues in Effectiveness of Body Armor

Questions about the effectiveness of body armor, as well as the physical and environmental influences exerted on armor, were raised following the failure of a Zylon®-based body armor vest worn by a Forest Hills, Pennsylvania officer who was seriously injured in 2003. The Zylon® in the vest was found to degrade and thereby weaken when repeatedly exposed to heat and humidity combined with perspiration. While all fibers will degrade to some degree over time (hence the need for armor replacement after some time), the extent of the degradation and subsequent failure in the Zylon®-based vest was unexpected. In response, DOJ announced the Body Armor Safety Initiative in 2003 to examine Zylon®-containing vests as well as to review the testing process for vests. The Office of Law Enforcement Standards conducted extensive research into the cause of the failure, with additional testing and research into the effects of aging on the ballistic performance of armor. Prior to this failure, NIJ's standards (Body Armor Standard 0101.04) had not initially included standardized test protocols that subject body armor to artificial aging conditions (NIJ, 2001). NIJ then introduced the *NIJ 2005 Interim Requirements for Bullet-Resistant Body Armor* followed by a draft of the new updated 2006 standards that adds new, highly rigorous levels of threat at the testing level in order to maintain safety measures. Some of the updated changes for the 2006 NIJ standards include:

- Standardized projectiles to include narrower ballistics
- Increased potential threat level (e.g., a change in round threats; required submersion rather than shower testing for wet conditions)
- Increased test sample quantities
- Increased labeling and workmanship requirements
- Added a new statistical method that will play a role in the pass/fail criteria of 2006 models
- Reduced shot-to-edge distance
- Require testing of multiple armor sizes
- Retooled perforation backface signature requirements
- Improved ballistic limit testing
- Created new level of environmental conditioning to mimic field use (e.g., humidity and rough handling)

These improved standards ensure the ability to anticipate the degree of distress body armor will have after five or six years of use, and augment safety standards accordingly (www.policeone.com).

The Benefits of Lightweight Body Armor Use for Officers

For more than two decades, lightweight body armor has been made widely available to law enforcement personnel and, to date, more than 3,000 lives reportedly have been saved by the use of this personal body armor (National Law Enforcement and Corrections Technology Center, 2006; NIJ 2001). The International Association of Chiefs of Police (IACP)/DuPont Kevlar Survivors' Club® commemorated the 3,000th body armor "save" in March 2006 (IACP/DuPont Kevlar Survivors' Club®). Lightweight body armor used by law enforcement personnel is recognized as playing a major role in saving officers from death or serious injury. The Federal Bureau of Investigation (FBI) concluded that the risk of sustaining a fatal injury for officers who do not routinely wear body armor is 14 times greater than those who do (FBI Uniform Crime Reports: Officers Killed and Assaulted, 1994).

Since the FBI began reporting data in the 1970s, through its Law Enforcement Officers Killed and Assaulted (LEOKA) reports, the number of officers feloniously killed in the line of duty decreased from more than 90 in the years preceding 1983 to a low of 42 in 1999, a decline which could be partly attributable to the increased use of body armor (Fridell and Pate, 2001). Wearing body armor is clearly critical to officer safety in law enforcement work, according to the available statistics. Between 1973 and 2001, a total of 2,500 "saves" were attributed to the use of body armor, 58 percent of which were connected with felonious assaults (40 percent of which were felonious firearm assaults and 12 percent cutting/slashing assaults), and 42 percent with accidents (for example, car accidents, where body armor often helps absorb the force of impact and protects accident victims' internal organs). Body armor clearly offers non-ballistic protection, as well. While there is specific body armor that offers protection against stabbing and knives, the current surge of body armor development focuses mostly on protection against firearms (NIJ, 2001). Since the 1970s, the Federal Bureau of Investigation's Uniform Crime Reports (UCR) and LEOKA database have continued to provide evidence that the most common threat faced by officers is firearm assaults. From 1985 to 1996, 840 officers were feloniously killed in the line of duty.[11] Of these, 769 (91.5 percent) were killed with firearms—605 (72 percent) by handguns, 114 (13.6 percent) by rifles, and 50 (6 percent) by shotguns. The other 71 officers (8.5 percent) were killed with other types of weapons. Of the 605 deaths from handguns, 9mm handguns or lesser handguns were used in 500 (82.6 percent) of the cases. Lightweight body armor is most typically designed to offer protection against these types of handguns.

More recently, the importance of body armor use has again ascended to the forefront for police agencies nationwide. Along with the increase in firearm use and violence nationwide (FBI 2006 UCR data), there has been an upward swing in 2007 in the number of officers killed in the line of duty. In 2007, there were 68 officers fatally shot, an increase of over 30 percent from the same period in 2006 (National Law Enforcement Memorial Fund). With an increase in violence and reports by police chiefs of a greater disregard for authority and the police, the need for officers to use body armor is perhaps even more critical. The National Law Enforcement Officers Memorial Fund has reported that over the past decade, 43 percent of the 1,631 officers who died of any cause in the line of duty were not wearing body armor. The National Law Enforcement Officers Memorial Fund data for 2006 indicates that 43 percent of all the officers killed (whether assaulted or in accidents) in 2006 were not wearing body armor. Statistics for officers feloniously killed for 2006 show that, of the 48 officers who were feloniously killed in the line of duty, 46 were killed by firearms—35 with handguns, 8 with rifles, 2 with shotguns, and 1 with an unknown firearm. Twenty-two of these officers were not wearing body armor (McGinn, 2007).

Since the late 1980s, there has been a strong push to educate officers and agencies on the benefits of wearing body armor and to develop policies and practices that increase the wearing of armor.[12] In 1987, the IACP/DuPont Kevlar Survivors' Club® was formed

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11 From 1996 to 2005, 575 officers were feloniously killed, 68.5 percent by hand guns.

12 A study by DuPont done in 1987 (as reported in U.S. Department of Justice, 2001) found that while most law enforcement officers recognized the dangers of their jobs and 65 percent of those surveyed owned body armor, only 15 to 20 percent actually used it. The reasons given for not wearing body armor ranged from legitimate concerns such as comfort and weight, to misconceptions about an officer's ability to survive blunt trauma caused by a bullet that has been stopped by a vest.

with an objective of decreasing officer deaths and disabilities by encouraging the wearing of body armor. In 1999, the Department of Justice began the Bulletproof Vest Partnership (BVP) Program to provide funding to state and local law enforcement agencies for the purchase or replacement of vests. Since 1999, more than 11,900 jurisdictions have participated in the DOJ BVP Program, with $173 million in federal funds committed to support the purchase of an estimated 450,000 vests (see www.ojp.usdoj.gov/bvpbasi/). The IACP has produced publications that provide information about, and encourage the use of, body armor among law enforcement agencies. In 1999, the IACP passed a resolution recommending that all police executives communicate the importance of wearing body armor and that all law enforcement agencies take steps toward the proper fitting of body armor, adopting a wear policy for all on-duty field and investigative personnel, and conducting periodic inspections to ensure that the armor fits properly and is in good condition, replacing defective armor as needed (IACP.org).

Body Armor Research

Despite the fact that the law enforcement community has been using body armor for more than 30 years to reduce officer deaths and injuries, many questions remain unanswered with respect to body armor use within law enforcement agencies, including departmental policies regarding wear and maintenance, as well as policies on post-incident procedures.[13] A review of the literature reveals very little prior research in this area; any research that is available focuses on specific issues, such as the relatively recent failure of Zylon®-based body armor (NIJ, 2005).

One of the few sources of systematic data on body armor policies comes from the Bureau of Justice Statistics (BJS) through the Law Enforcement Management and Administrative Statistics (LEMAS) survey. The dramatic increase in the general acceptance of body armor can be shown by examining the LEMAS data from 1987 to 1993 to 2000. In 1987, only 28 percent of agencies surveyed by BJS provided armor or a cash allowance to purchase armor for all of their uniformed patrol officers. However, by 1993 that figure had climbed to about 82 percent, and it rose to more than 90 percent in 2000. Also, in 1990 approximately 21 percent of all the agencies surveyed had a policy requiring uniformed patrol officers to wear body armor at all times while in uniform. By 1993, that figure had climbed to 30 percent, and by 2000, 47 percent of the agencies had a mandatory wear policy for all uniformed patrol officers. However, this percentage has not changed significantly in the last 6 years (from 2000 to 2006).

The FBI's UCR data include the collection of data relevant to law enforcement body armor policies. UCR data point to the importance of using armor that provides *fuller coverage* of officers' bodies. According to detailed UCR data from 1985 to 1996, 288 officers were killed while wearing protective armor during this period.[14] Of those officers, 58.7 percent were killed by gunshot wounds to the head, 28.5 percent died as a result of gunshot wounds to the upper torso, 6.9 percent died as a result of gunshot wounds below the

13 Currently unpublished research by Akron General Hospital and Northeastern Medical College addresses policies pertaining to the aftermath of an officer shooting when the officer was wearing body armor, specifically policies regarding officer medical transportation and examination of the vest to inform medical assessment of officers.

14 More recent data show similar results. According to the UCR data from 1996–2005, 311 law enforcement officers were killed while wearing protective armor. Of these, 103 officers (who were wearing body armor) were killed by a bullet that penetrated their torso. Twenty-one of the 103 officers were killed after a bullet penetrated their armor (1 by handgun and 20 by rifle).

waist; 3.5 percent were intentionally struck by automobiles; 1 percent were stabbed; and 1.4 percent died by other means. Of those officers killed by gunshot wounds to the upper torso, 51.2 percent were killed when the round entered the torso region between the panels of the vest or through the arm openings, and 26.8 percent were killed when the round landed above the coverage area of the vest. Fourteen of the 82 officers killed by gunshot wounds to the upper torso died as a result of rounds penetrating the body armor. Of these 14 incidents, 11 were the result of rifle rounds, which the armor was not designed to protect against. The other three were the result of handgun ammunition. However, in only one of these cases was it confirmed that a round fired from a handgun actually penetrated the armor. In this case, the officer was wearing a vest that provided front-only protection; the penetrating round exceeded the protection capabilities of the vest, and the second, fatal round impacted an area not protected by the vest.

As a result of the findings of this UCR data, particularly those findings that pertain to penetration and coverage area of body armor, the NIJ's body armor standards calls for vests to provide full frontal, side, and back protection with the wrap-around portion going from front to back. Also, NIJ body armor standards highlight the importance of the proper fitting of body armor and routine inspections to ensure adequate coverage and protection with officers individually measured and fitted for concealable body armor.

Aside from research on the technology of armor development, there exists only a small body of additional research, between 1979 and 2006, that explores body armor use and related issues. This includes the previously mentioned BJA-funded PERF Phase One Body Armor study in 2005, the purpose of which was to explore the 100 largest police agencies' use of Zylon®-based vests after the Zylon® failure that led to NIJ's Body Armor Standard Advisory Notice #01-2005.[15] Topics covered include officer preferences in body armor, armor degradation concerns, provision of body armor by law enforcement agencies, policies on wear, and the recent Zylon® failure. Ongoing technological advances and developments in the requirement standards for production of body armor have addressed many of the concerns raised in earlier research.

The table in Appendix A summarizes the key research studies that exist on body armor use and policy. The fact remains that very little social policy research has been conducted in the area of body armor or the effect of police agency policies on body armor usage and officer behavior and outcomes. The available body of research explores the various topics in body armor ranging from the development and testing of armor to an exploration of various agencies and officers' armor wear policies and approaches. In the mid-1980s and again in the early 2000s, NIJ and DuPont conducted several studies into the various factors that affect body armor aging and degradation. The 1983 and 1986 studies found that aging alone does not degrade body armor, and the armor being tested had been in use for as long as 10 years. The later studies, conducted after the Zylon® failures, found that Zylon® vests were penetrable in certain circumstances and could degrade under certain environmental conditions. The 2005 study also focused on Zylon® armor and its use, with the finding that more than a third of

15 PERF's 2005 Body Armor Survey of the 100 largest law enforcement agencies achieved a 93 percent response rate.

agencies still used the Zylon® vests at the time of the study. Other studies of body armor use include a 1979 study of Illinois officers and their body armor preferences and use, as well as a 2006 study of small and rural police agencies' body armor wear and policies. Most of the existing research clearly focuses on very specific areas or is limited to certain agencies or states only.

To address the above gaps in the research literature on departmental policies and practices regarding wear and maintenance of body armor, PERF and BJA launched the study described in this report. This study takes a more systematic approach and assesses the differences across law enforcement agencies nationwide in their policies and practices regarding body armor use. In the sections that follow, we describe the most extensive exploration to date into the use of body armor by law enforcement, the provision of body armor to personnel, and policies about wear and replacement. This study will provide insights into how such practices and policies affect officer safety, and will help police agencies develop, implement and promote practices that will improve the safety of officers, and decrease injuries and deaths in law enforcement. The next section outlines our survey research methods briefly, followed by the survey results and a concluding section.

Research Methods

In this section, we briefly review the methods used in our study. We provide a more detailed review of our study methods in Technical Appendices C and E. PERF contracted with Tailored Statistical Solutions, LLC (TSS) to draw a stratified nationally representative sample of municipal, county, and state law enforcement agencies (both police chiefs and sheriffs) that would receive the body armor survey. The sample was drawn from a census directory of the universe of U.S. state and local law enforcement agencies known as the 2006 National Directory of Law Enforcement Agencies (NDLEA) database. This database contained information on 16,100 law enforcement agencies from around the U.S.

PERF assembled a technical advisory group of practitioners and academic experts to help develop a draft survey, and then 15 PERF staff members—researchers and former law enforcement practitioners—reviewed the draft. PERF also sent the draft survey to a dozen agencies for pilot testing. PERF used multiple waves of surveys, reminder letters, faxed reminders, and telephone calls to achieve a high response rate (80 percent). All surveys were reviewed in order to resolve any questions about missing or unclear information. See Appendices C and E for more detailed information about the survey methodology.

The Body Armor Survey Findings

The purpose of the BJA/PERF National Body Armor Survey was to assess current body armor policies and practices in law enforcement nationwide and to gather data on officer safety outcomes. With the proliferation of firearms and the increase in firearm violence nationwide, the protection of the officers who protect and ensure the safety of our communities is a critical concern. Therefore, the outcomes of a comprehensive assessment of how the nation's police agencies use and promote body armor will inform national discussion, policy development, and programming on officer safety.

The BJA/PERF Body Armor Survey was sent to a random sample of over 990 agencies and had a high response rate. The responses received from nearly 80 percent of these law enforcement agencies throughout the United States provides a detailed insight into agencies' practices, policies, and standards regarding body armor for their officers.

The data from the 782 participating agencies were cleaned, statistically weighted, and analyzed. The findings are categorized into the following topic areas: law enforcement agency characteristics; body armor usage and policies on the use of body armor; types of body armor; officer injuries and deaths; purchasing decisions; and maintenance, training, and inspection. (It is important to note that the data are weighted[16] to assure that they represent the experiences of all the nation's state and local law enforcement agencies.)

Results for All Law Enforcement Agencies in Our National Sample

First, we present our results for all the agencies in our sample, applying a statistical weighting scheme to assure that our results are representative of the entire nation's state and local law enforcement. Later in this section, we provide a similar weighting scheme, but present our results by law enforcement agency size.

The departments surveyed

To see whether we were successful in reaching a representative group of law enforcement agencies from across the country, we used Question 1 of the survey to ask respondents for information about the number of personnel in their agency and the population served. As seen in Table 1, the survey sample is a balanced representation of the population of law enforcement agencies in the field—with the sample's mean agency size of 44 total sworn personnel. Within the United States,

16 Sampling weights are adjustment factors we applied to our dataset to correct for differences in the probability of selection between agencies in our sample and their actual representation within the population of all law enforcement agencies in the U.S. The weights have been applied to all of our tabulations and percentages to produce the proper representation.

the majority of agencies (52 percent) employ fewer than ten officers.[17] We weighted our sample results to ensure that our findings are similar to results found as if we surveyed every law enforcement agency in the United States. The total number of departmental personnel of all the responding agencies, ranged from 1 to just over 50,000 with a mean of about 60 employees. Of these, the number sworn personnel ranged from one to nearly 36,000, with a mean of 44 sworn personnel and the majority of these personnel dedicated to patrol work. We also have represented in our sample a range of jurisdictions with populations fewer than 100 to 37,000,000 people with an average population of about 50,000.

Officer protection: sidearms issued

Officers are offered various forms of protective equipment and techniques to maintain their safety on the job. In addition to body armor, sidearms are also a form of protection used by officers in the field. In assessing officer safety, we therefore also looked at the various sidearms that are issued to officers for protection across the nation. Furthermore, in order to gauge whether body armor provided by law enforcement agencies is rated highly enough at least to help protect officers against the types of weapons that they themselves carry, the questions focused on the types of sidearms—primary, secondary and less-than-lethal weapons—that are issued or authorized for use by officers in the responding agencies. The first question focused on the caliber of the primary firearm issued or authorized for officer use by the majority of agencies. The large majority (72.9 percent) issue or authorize the .40 caliber firearm as the primary sidearm. Below, in Table 2, we outline these results.[18]

Table 1. Agency demographics

Agency demographics	Mean	Range
Number of total personnel	63.28	Min. = 1, Maximum = 50,933
Number of sworn personnel (all ranks)	44.17	Min. = 1, Maximum = 35,852
Number of sworn patrol personnel (all ranks)	28.57	Min. = 0, Maximum = 31,101
Service population of jurisdiction	50072.17	Min. = 4, Maximum = 37,000,000

Table 2. Primary sidearm

Caliber of primary sidearm issued	Percentage of departments
.40 caliber	72.9%
.45 caliber	24.9%
.45 and/or 9mm	24.4%

17 Of the 17,876 state and local law enforcement agencies (with at least one full-time officer) operating as of September 2004, 1,099, or 6.1 percent, employed 100 or more full-time sworn personnel (Reeves, 2007). Despite the small number of these very large police forces, they employ the majority of officers in the U.S. The state and local agencies with 100 or more full-time sworn officers employed 63 percent of all state and local full-time sworn personnel.

18 Percentages do not add to 100 percent because respondents could check "all that apply."

Respondents also were queried about secondary firearms systems that are issued to patrol officers or authorized for their use. The majority of law enforcement agencies (85.0 percent) issue or authorize the use of shotguns as the secondary firearm. The results are summarized in Table 3 below.[19]

Finally, respondents were asked to indicate which less-lethal weapons are issued to patrol officers or authorized for their use. Table 4 outlines the less-lethal weapons that are most commonly issued to patrol officers or authorized for their use. The findings indicate that the personal issue chemical agents (OS and CS) (89.4 percent), as well as the expandable baton (83.7 percent), are the most common less-lethal weapons issued or authorized for use by most departments. Also notable is that almost half of the agencies (47.9 percent) issue CEDs (Conducted Energy Devices, also commonly known as Tasers™) to their officers.

What body armor policies do law enforcement agencies have in place?

Our first series of questions in this area focused on the use of, and policies related to, body armor. Survey respondents were first asked about their officers' use of body armor/bullet-resistant vests. The overwhelming majority of agencies (*99.4 percent*) indicated that their officers currently use body armor. Just over half of the agencies surveyed (59 percent) indicated that they *require* their officers to wear body armor at least some of the time (see Figure 1).

But often the requirement has not been reduced to writing; slightly fewer than half (45 percent) of the responding agencies indicated that they have a *written* policy requiring their officers to wear body armor (see Figure 2). While we did not collect data on this issue, the absence of a written policy in this area could lead to compliance problems with body armor wear requirements among officers. Of

Table 3. Secondary firearms issued

Secondary firearms issued	Percentage of departments
Shotgun	85%
AR-15	50%
Rifle	23.1%

Table 4. Less-Lethal weapons issued

Type of less-lethal weapon	Percentage of departments
Personal issue chemical agents (OS, CS)	89.4%
Expandable baton	83.7%
CED	47.9%
Straight or side handle batons	30.9%

19 Percentages do not add to 100 percent because respondents could check "all that apply."

the departments with written policies, (see Table 5[20]), a significant majority had mandatory wear requirements for their recruits[21] (84.2 percent), patrol officers (91.0 percent), and tactical units (85.4 percent), while approximately one-third of departments with written policies required their detectives and undercover officers to use body armor. Given the greater danger associated with tactical work, we were surprised we found that some tactical units (14.6 percent) do not have written requirements to wear body armor. Also, we need to collect more data in the future about the reasons that approximately

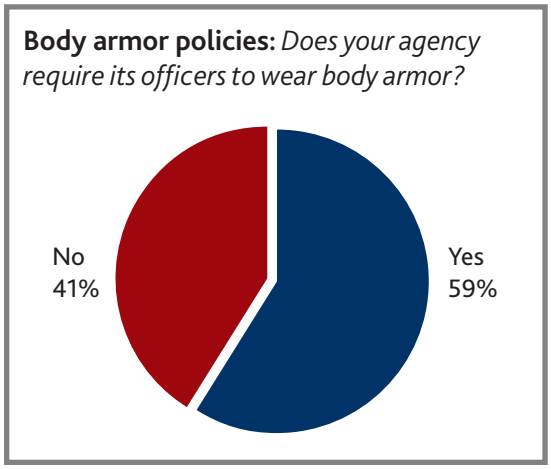

Figure 1. Agencies requiring wear of body armor

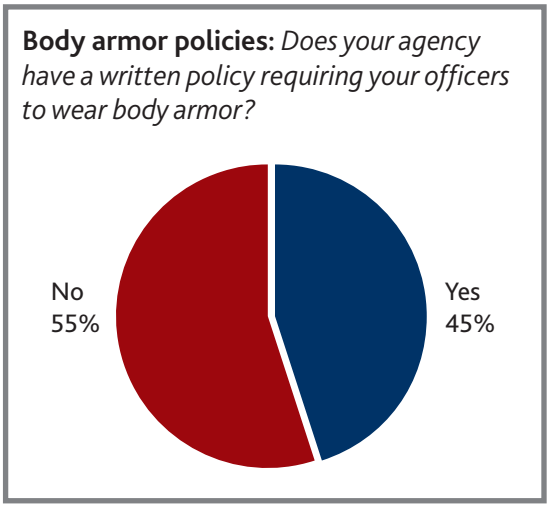

Figure 2. Agencies with *written* policy requiring body armor

Table 5. Agencies with a written policy requiring specific personnel to wear body armor

Category of personnel with written policy	Percentage of agencies
Recruits–mandatory	84.2%
Patrol officers–mandatory	91.0%
Detectives–mandatory	30.1%
Tactical team–mandatory	85.4%
Undercover–mandatory	33.7%
Command staff–mandatory	47.2%
Chief/Sheriff	33.6%

20 In Table 5, the percentages of agencies with "mandatory" policies include those who identified their policies as "mandatory by policy with no exceptions" or as "mandatory by policy with exceptions"—as opposed to those who checked "not mandatory but required under certain special circumstances" or "not mandatory."

21 Recruit officers refer to those officers who are in training to become law enforcement officers.

two-thirds of detectives do not have written requirements to wear body armor at least some of the time.

We also asked respondents to describe their agency's disciplinary policy when an officer does not wear body armor when required to do so. Most commonly, departments will give a verbal reprimand (27.2 percent), written reprimand (26.6 percent), and/or suspension (18.3 percent) if an officer is found to have violated departmental policy concerning the wearing of body armor.

While less than half of agencies mandate that body armor be worn via a written policy, almost all support it fiscally by issuing or at least providing reimbursement for armor and trauma plates to officers. More specifically, almost all the agencies surveyed clearly indicated that their officers do wear body armor. Written policies typically mandate wearing of armor for patrol, recruit, and SWAT officers. The great majority supply armor to their officers, and those that do not issue armor at least tend to reimburse officers who buy it. It is only a slight fraction that does neither. Therefore, it is evident that law enforcement agencies nationwide promote body armor usage. It is important to note, however, that any federal body armor program that provides funding to agencies to promote body armor use might find it problematic to restrict the grants to agencies that have a mandatory wear policy, given that this would exclude more than half of the law enforcement agencies.

Is Zylon®-based armor still in use?

Another area that was explored was whether any departments currently use body armor containing Zylon.®[22] This is an important question because in August 2005 the U.S. Department of Justice (DOJ) announced that Zylon®-containing body armor might not provide sufficient ballistic resistance, thereby seriously compromising officer safety. Surprisingly, of the departments that currently use body armor, 8.1 percent still use body armor partly or entirely composed of Zylon® (see Figure 3). Even more surprising, of the departments that are currently using Zylon®-based body armor, fewer than 20 percent (19.5 percent) plan to replace it, while 75.4 percent of the departments are unsure what they will do. Of those departments that do plan to replace their Zylon®-based body armor, most will use their existing budget (49.2 percent) or will do so through an exchange with the manufacturer (17.1 percent); many of these departments have yet to determine how to replace such body armor.

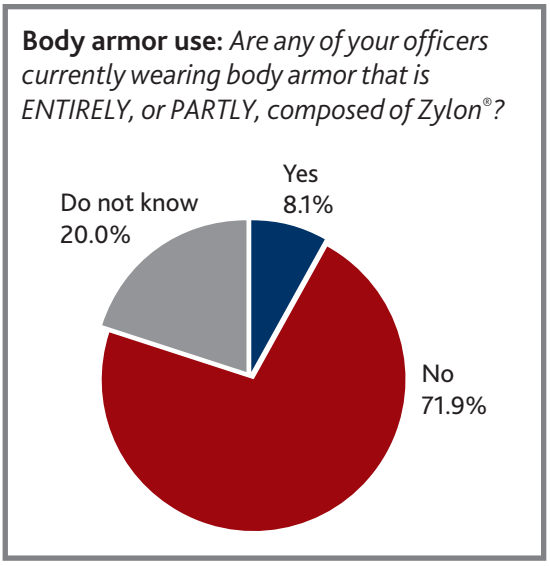

Figure 3. Agencies whose officers use armor composed of Zylon®

22 Zylon® (PBO fiber–poly-*p*-pheylene benzobiasoxazole) is a high-strength organic fiber produced by the Toyobo Co., Ltd. Zylon® is a registered trademark of the Toyobo Co., Ltd.

What brands and levels of body armor do police typically use?

The study also assessed which brands of body armor were commonly used by law enforcement agencies, along with the type (level of protection provided according to NIJ standards) of body armor (see Figures 4 and 5 below). The highest percentage of respondents indicated that their officers wear body armor produced by Second Chance (33.8 percent), followed by American Body Armor (31.6 percent), Safariland (19.6 percent), and Point Blank (19.3 percent).

Next, most state and local law enforcement agencies in the United States use body armor rated at Level 2 (41.4 percent) or Level 3a (35.0 percent).[23] Overall we found a degree of uniformity in the level and brands of body armor that agencies use (mostly Type II and Type III-A). Most agencies do not use body armor that protects against rifle fire or armor-piercing bullets, but most agencies at a minimum use body armor that protects officers against 9mm and .40 caliber bullets.

Overall, these levels of protection offered to officers should be sufficient against most handgun threats, but not against threats from high caliber weapons or rifles. Also, higher level armor is recommended for tactical situations and the level of armor chosen for law enforcement agencies for those situations should be routinely reviewed, for the weapons used by various serious violent criminals may change more rapidly than the weapons used by typical street criminals.

The survey also contained a question concerning the type of "carrier"—the garment that contains the body armor protective panels—used by departments. Specifically, respondents were asked if their departments use internal carriers (i.e., the officer wears body armor under the uniform shirt)

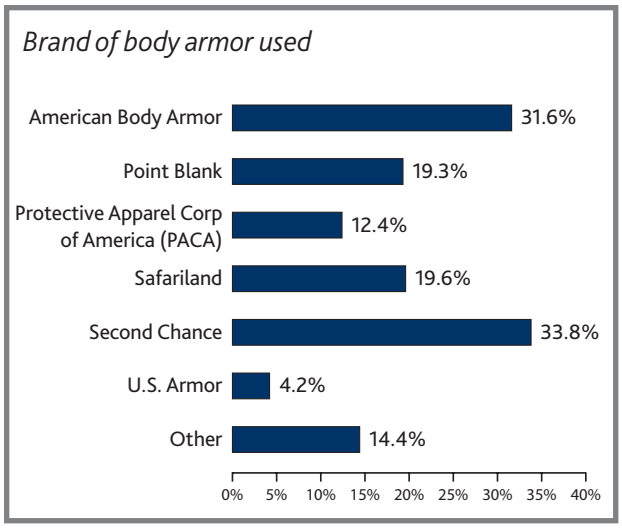

Figure 4. Brands of body armor used

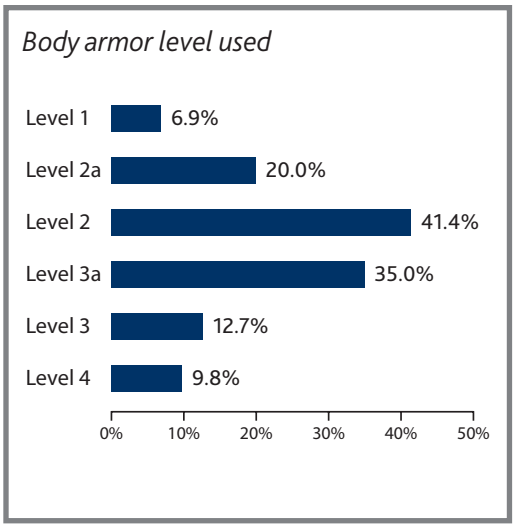

Figure 5. Level of body armor

23 Armor Level definitions were outlined in the earlier section of the report. Also, percentages exceed 100 percent as some agencies typically purchase one level of armor for their patrol officers and may purchase different levels for other units (e.g., SWAT). And agencies whose officers purchase their own armor allow the officers to choose their own brand and level of armor.

or external carriers (i.e., the officer wears body armor over the uniform shirt) for their body armor. The vast majority of departments use internal carriers (57.4 percent) or use both internal and external carriers (41.4 percent); only 1.2 percent use only external carriers. While not a part of our survey, most departments probably use the internal carrier because it is concealable behind the uniform and makes the officer perhaps more approachable (as opposed to the external carrier which makes the officer look more like a combat soldier).

How much protection does body armor offer?

The third section of the survey contained a series of questions concerning officer injuries and deaths, as well as body armor use and coverage in those instances. Fortunately, 94 percent of the law enforcement agencies surveyed said they had not had any officers shot in the line of duty over the last five years, and 93 percent said they had not had any officers assaulted with an edged weapon such as a knife in that period. This result is consistent with the FBI's Law Enforcement Officers Killed and Assaulted (LEOKA) data.

Firearm shootings of officers in the line of duty over the past five years were relatively rare; most agencies (94.3 percent) reported not having any such incidents (see Figure 6). The full table of specific percentages for the agencies reporting any officer shootings (Table II) can be found in Appendix D).

Of the departments that reported any officer shootings, the number of officer shootings ranged from one to 61, but a significant majority reported one such incident. Of the agencies reporting officers shot, most (79.6 percent) reported that none of their officers were shot in an area of the body covered by body armor (see Figure 7). Detailed percentages and breakdowns can be found in Table III of Appendix D.

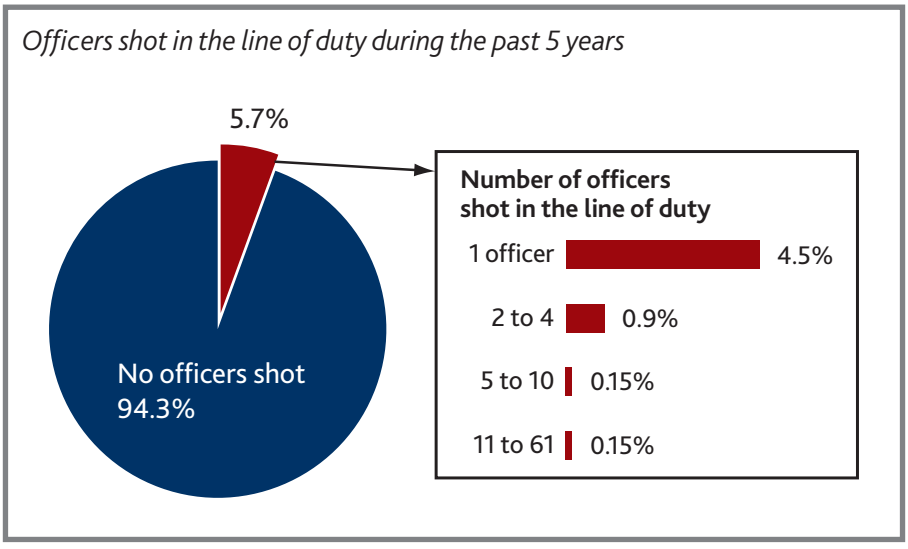

Figure 6. In the past five years, how many officers were shot in the line of duty?

Officer deaths generally result from being shot in an area of the body that is not covered by body armor. This is an important finding. Officer safety experts need to consider the many dangers officers face, including the risk of being shot in an area not covered by body armor. While this survey did not delve into where on the body officers were shot, FBI LEOKA data is available to supplement our findings. LEOKA data is available for those felonious shootings of officers that resulted in death for the 1997–2006 period, with 306 of 521 officers who were feloniously killed during this period wearing body armor. For those officers who were wearing body armor but were fatally wounded, 165 of the 306 (54 percent) were shot in the head area, 29 to the neck/throat area and 103 (34 percent) in the torso area. For those shot in the torso area, 20 penetrated the vest because the vest was not designed to stop that particular weapon, while the remainder entered the torso through open side or shoulder panels, or above or below the vest. One body armor failure was reported by LEOKA for the 1997–2006 period.

Also our finding that many firearm assaults against officers do not occur in an area covered by body armor implies that in addition to body armor, other protection should certainly also be considered (e.g., enhanced training on using cover/concealment during firearm incidents).

Nearly all responding departments (99.2 percent) have not experienced any officer shooting deaths within the past five years. Of those departments that indicated that at least one officer died as a result of a gunshot wound suffered in the line of duty, the number of deaths ranged from one to 26, but the vast majority indicated the number to be two or fewer (see Table 6).

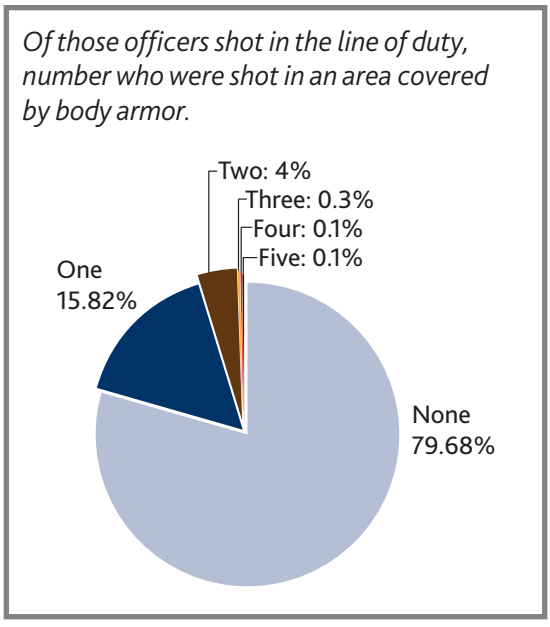

Figure 7. Of these officers who were shot in the line of duty, how many were shot in an area covered by body armor?

Table 6. In the past five years, how many officers from your agency died as a result of an injury from a gunshot wound suffered in the line of duty?

Number of officers who died as a result of a line of duty shooting	Percentage of agencies
None	99.2%
One officer	0.6%
Two officers	0.2%
Three officers	Less than 0.1%
Four officers	Less than 0.1%
Five officers	Less than 0.1%
Six officers	Less than 0.1%
Twenty-six officers	Less than 0.1%

Again, of the agencies reporting officer deaths, almost three-quarters (73.3 percent) reported having officers shot and killed in an area of the body other than that covered by body armor (see Table 7). Only a small number of officers were shot and killed after sustaining a bullet wound in an area covered by the body armor (e.g., shot with an armor piercing bullet).

Another question focused on all of the officers who were shot, fatally or nonfatally, in an area of the body covered by body armor. 7.5 percent of agencies indicated they had one or two officers die possibly as a result of body armor failure (see Table 8).[24]

While our survey did not include a forensic investigation of possible body armor failure, the respondents reported that body armor failure is extremely rare. Fifty-one of our sample of 782 agencies had an officer who died from a shooting, and 14 of those agencies had an officer killing involve a case where an officer was shot in an area covered by body armor. Also, only two of the agencies in our sample reported having an officer fatality attributed to a possible body armor failure.

While the primary protective function of body armor is protection against firearm bullet penetration, a side benefit that body armor has been found to have, is in its ability to help

Table 7. Of the officers who died as a result of a line of duty shooting, how many were shot in an area covered by body armor?

Number of officers	Percentage of agencies
None	73.3%
One officer	24.7%
Three officers	1.2%
Four officers	0.9%

Table 8. How many of these officers who were shot in an area covered by body armor died as a result of a possible body armor failure? Do not count cases in which the officers were shot with a weapon that the body armor was not designed to protect against.

Of the officers who died, the number of officers who died as a result of possible body armor failure	Percentage of agencies
None	92.5%
One officer	3.1%
Two officers	4.4%

24 We recognize that thorough forensic/technical investigations are necessary to determine if armor failures occurred. This question is relying upon the opinion of police personnel based upon their overall understanding of the individual shooting case.

with protection against edged weapons such as knives. As a result the survey also extended some of the above questions to include exploration of protection against edged weapon attacks in an attempt to further explore the added protective capability of body armor.

The survey also asked respondents to indicate the number of officers over the past five years who were assaulted in the line of duty by suspects using edged weapons (e.g., knives) (see Figure 8 below and the full table [Table I] in Appendix D). The vast majority of responding departments (93.7 percent) did not have any officers who were assaulted with an edged weapon in the past five years. Of those departments that did report an assault of an officer with an edged weapon, the number of officers who were assaulted ranged from one to 127, but the majority of departments reported one or two such assaults. The majority of agencies (80.1 percent) reported that of officers who were assaulted with an edged weapon, none were stabbed or cut in an area covered by body armor (see Table 9). Of the officers who had been stabbed or assaulted in an area covered by body armor, all survived the incident, possibly suggesting that their body armor helped to protect the officers. In fact, regardless of which part of the officers' bodies were stabbed or otherwise assaulted, no officers died as a result of an assault with an edged weapon over the past five years (see Table 10).

How do law enforcement agencies choose and purchase their armor?

Procurement policies for body armor are important due to the resultant outcomes (e.g., the acquisition of lower quality body armor) if agencies do not institute policies that ensure open and objective bid and procurement standards. The fourth section of survey contained questions about the purchase of body armor and factors contributing to the choice of body armor as well as questions concerning whose responsibility it is to purchase body armor.

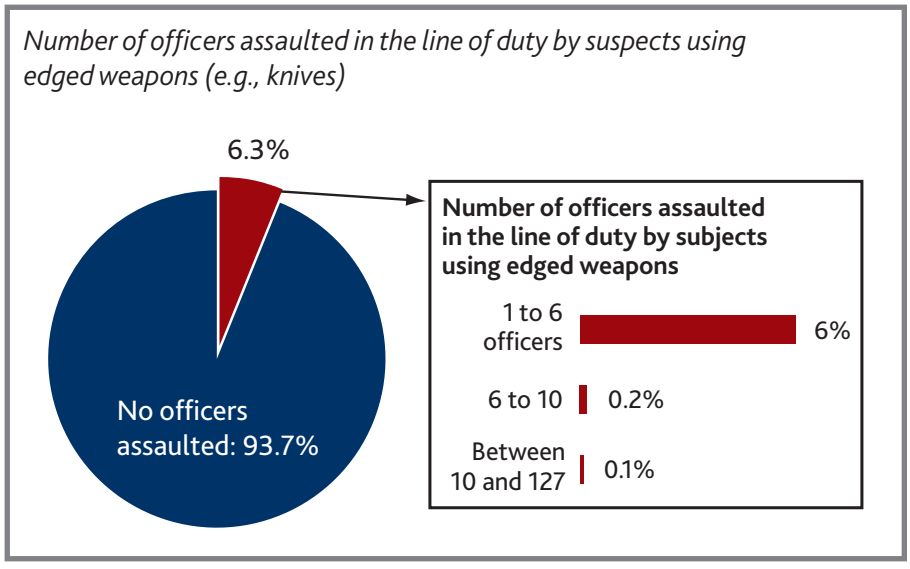

Figure 8. In the past five years, how many officers from your agency were assaulted in the line of duty by suspects using edged weapons (e.g., a knife)?

That is, does the agency issue body armor or is it the responsibility of the individual officer to purchase his/her own body armor? As indicated in Table 11, the vast majority of departments (87.4 percent) issue body armor to their officers. Slightly fewer than 20 percent (17.7 percent)[25] of the respondents indicated that their officers purchase their own body armor. For those agencies that do require their officers to purchase their own body armor:

- 37.4 percent provide full reimbursement, and
- 62.6 percent provide partial reimbursement (ranging from 33 percent to 100 percent).

We asked respondents to indicate if trauma/ballistic plates are issued (purchased) by the agency or whether it is the individual officer's responsibility to purchase such protection. (Trauma/ballistic plates are devices that can be added to the vest over a certain area, most commonly the mass center of the torso, to increase protection against broken ribs or other internal injuries that can occur even if the armor is not penetrated. Trauma plates can be made of metal wrapped in rubber or ballistic fabric, or of additional layers of ballistic fabric.) The majority (70.7 percent) of the departments indicated that they do issue trauma plates, while 28.5 percent indicate that they do not issue such ballistic protection to their officers. Almost 21 percent[26] of the respondents indicated that their

Table 9. Of these, how many were stabbed/cut in an area covered by body armor?

Of those stabbed, number of officers stabbed/cut in an area covered by body armor	Percentage of agencies
None	80.1%
One officer	18.4%
Two officers	0.5%
Four officers	1.0%

Table 10. In the past five years, how many officers from your agency died in the line of duty as a result of an edged weapon attack?

Number of officers who died from line of duty edged weapon attack	Percentage of agencies
None	100.0%

Table 11. Policies on body armor purchase

Purchasing body armor	Percentage of agencies
Agency responsibility to purchase	87.4%
Individual officer responsibility to purchase	17.7%

25 Some departments provide body armor to some officers (e.g., tactical) and require other officers (e.g., patrol) to acquire their own body armor. Therefore, the percentages can exceed 100 percent.

26 Some departments provide trauma plates to some officers (e.g., tactical) and require some of their officers (e.g., patrol) to acquire their own trauma plates. Therefore, the sum of the percentages can exceed 100 percent.

officers purchase their own trauma plates. For those agencies that do require their officers to purchase their own trauma plates, 67.7 percent provide full reimbursement, while 32.3 percent provide partial reimbursement (ranging from 33 to 100 percent).

Over three-quarters of the departments surveyed (76.3 percent) purchase new body armor for their officers, and 14.4 percent of agencies have officers purchase their own armor. Slightly more than one-quarter (26.7 percent) of the law enforcement agencies engage in a competitive bidding process when acquiring new body armor, while approximately one-third (32.1 percent) are not required to engage in a competitive bidding process, and 18.5 percent use an existing agency-approved contract vehicle. Agencies were split somewhat equally on the whether they have specified standards for body armor performance: 41.5 percent indicated that they do not have such standards, while 48.3 percent indicated that they do (the rest were unsure).

Respondents were also asked to rate the importance of factors that might come into consideration when purchasing body armor (see Figure 9 below, and refer to Table IV in Appendix D for specific mean ratings for each factor).

Importance of factors considered when purchasing body armor

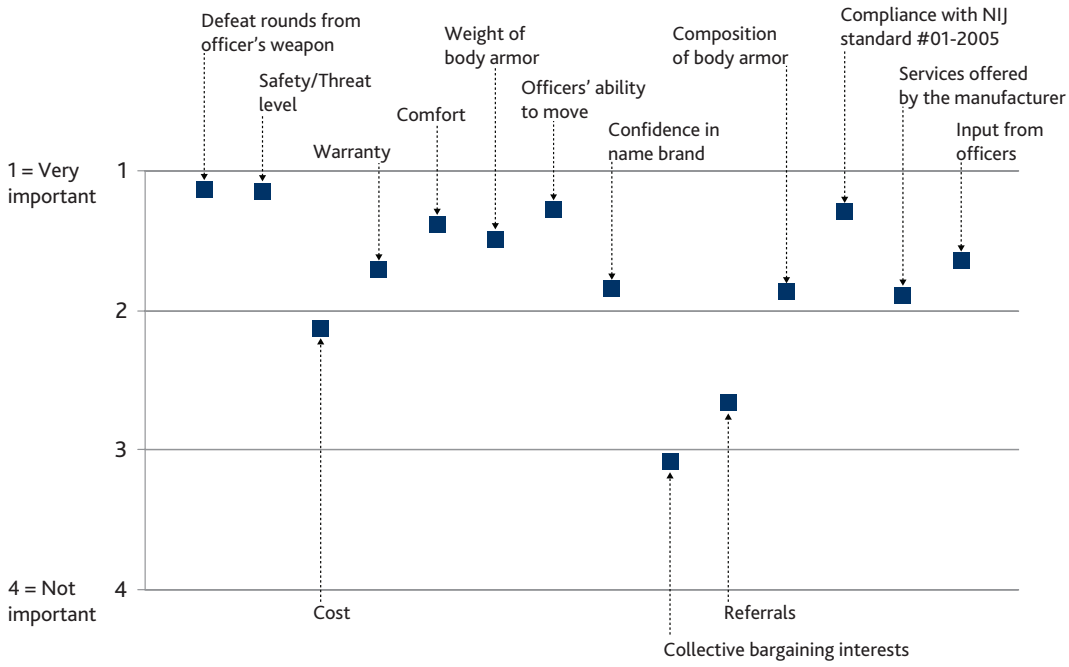

Figure 9. Rate the importance of the following factors related to the purchasing of body armor. 1=very important to 4=not important.[27]

27 Figure 9 shows the average scores (from 1 "very important" to 4 "not important") across all agencies as to how they rate each factor. The square dot indicates the average score for all agencies for the importance of a particular factor.

The primary factors that law enforcement agencies consider when purchasing body armor are whether the armor will defend against rounds from the weapon of the officer, the safety level of the armor, and compliance with NIJ standards. Other key factors they consider are comfort and weight, and officers' ability to move easily while wearing the armor. Clearly, safety and comfort exceed all other factors. The concern about safety could be due to the high-profile Zylon® failure that brought to light the importance of armor maintenance and testing as well as compliance with NIJ standards. Also, with the increased use of firearms in street-level crimes and criminals' increased use of higher power weapons reported by many police chiefs, armor standards are critical to officer safety and cannot afford to be compromised. Also, with the increase in the number of armor manufacturers and competitive pricing, as well as federal government assistance (e.g., through the Justice Department's Bulletproof Vest Partnership Program), law enforcement agencies are in a better position to ensure that safety is placed above cost.

Most (87.9 percent) of the departments indicated that officers are fitted for their body armor by manufacturer representatives (74.0 percent), by internal agency representatives (10.9 percent) or both (3.0 percent) (see Table 12). Surprisingly, about 12 percent of the departments said their officers are not fitted for body armor, other than receiving a size that approximates their body size. Given the importance of fit to the proper functioning of body armor—as highlighted in the NIJ body armor standards, this percentage is of some concern. It may be that ongoing education is still required in the area of fitting of body armor. The correct fitting of armor is crucial given that officers shot in the torso area can have bullets enter under their armor or through the side panels—as evidenced in the FBI LEOKA data on officers feloniously killed. Fitting therefore has the potential to be a largely overlooked factor in whether officers involved in shootings are injured or killed while wearing body armor.

For those respondents that indicated they did have a fitting for officers, almost all of the respondents (98.1 percent) indicated that this fitting takes place at the time the order is taken; and 42.3 percent of the departments also have an additional fitting upon delivery of the body armor to make sure it fits properly.

Table 12. Are officers fitted for their body armor?

Officers fitted?	Percentage of departments
No, officers receive body armor that approximates their body size	12.1%
Yes, officers are fitted by representatives from the manufacturer/supplier	74.0%
Yes, officers are fitted by internal agency representatives	10.9%
Officers are fitted by manufacturer AND agency representatives	3.0%

How do agencies fare in terms of training, maintenance, and inspection of armor?

The survey also asked about the education and training that officers receive on the benefits and limitations of wearing body armor, as well as on body armor care and maintenance (see Table 13). Little is known about how departments train their officers, who conducts this training and to what extent officers receive training. Additionally, given that NIJ standards also point to the importance of correct fit, maintenance, and replacement of armor to ensure proper functioning as well as minimization of degradation, these aspects of body armor training and maintenance are critical areas for departments to take note of.

Regarding the benefits and limitations of body armor, most of the respondents (74.9 percent) indicated that this education takes the form of manufacturer-provided literature or manuals (74.9 percent), education or training provided by the manufacturer/supplier representative (39.4 percent), and/or education provided during firearms training (36.4 percent).[28] Most often, education and/or training on the care and maintenance of body armor consists of manufacturer-provided literature or manuals (84.4 percent), information from the manufacturer/supplier representative (39.5 percent), and/or education provided during firearms training (19.4 percent).[29]

Next, respondents were asked to indicate whether or not their agencies conduct inspections to ensure that officers' body armor fits well and/or is maintained properly. The vast majority of agencies (90.4 percent)

Table 13. How does your agency educate/train its officers on the benefits and limitations of wearing body armor and on body armor care and maintenance?

Education/training?	Benefits and limitations of body armor	Body armor care and maintenance
Manufacturer-provided literature/manuals	74.9%	84.4%
Department-provided literature/manuals	6.0%	7.2%
Supervisory staff	20.2%	15.9%
Manufacturer/supplier representative	39.4%	39.5%
In-service/specialized training	15.4%	9.0%
Academy	24.5%	12.3%
Firearms training	36.4%	19.4%
Roll call	8.9%	4.8%
Other	0.2%	0.5%
None provided	5.6%	8.6%

28 Items do not add to 100 percent because respondents could check "all that apply."

29 Again, items do not add to 100 percent because respondents could check "all that apply."

do not provide for such inspections; only 9.6 percent of agencies conduct inspections to make sure the body armor fits properly and/or is maintained appropriately (See Figure 10). For the agencies that do conduct these inspections, most frequently, inspections for fit are conducted once a year or less (56.9 percent), while inspections for maintenance are conducted either "about once a month" (26.6 percent) or "about once a year" (35.2 percent).

Replacing body armor

The majority of law enforcement agencies surveyed (78.4 percent) do not have a database or automated record system for a body armor replacement schedule. Of the 21.6 percent that do, about three-quarters (72.9 percent) indicate that officers are given early notification to ensure on-time replacement of body armor. Nearly 23 percent of agencies have no policy concerning replacement of body armor, and 46.6 percent have a policy to replace their body armor every five years.

Once body armor has been replaced, departments must decide what to do with the body armor that is no longer being used. Most commonly, body armor is kept for off-duty use (26.7 percent), is donated or sold to other domestic law enforcement agencies (20.7 percent), is destroyed (17.3 percent), and/or is thrown away (13.6 percent).

Survey respondents also were asked whether an officer's body armor is replaced if it is damaged in a shooting or stabbing or is otherwise damaged during the course of service. About 87 percent indicated that their departments do automatically replace armor that is damaged during the course of service (Table 14); and almost all of the departments (98.6 percent) cover the replacement costs of damaged armor (Table 15). In case of emergencies, or if an officer is awaiting new body armor, 59.1 percent of departments have additional body armor available.

Respondents were asked to indicate if their department conducts testing on body armor to ensure that it functions properly by stopping rounds within its certified standards.[30] Most agencies (83.6 percent) do not conduct such testing. Of the 16 percent that do, most of the testing is done by the agency itself (90.1 percent). Additionally, respondents were asked if their agencies collect information pertaining to the performance and durability of their body armor. Approximately two-thirds (68.1 percent) of the responding departments do not collect this information.

Therefore, another significant finding was that, across the board, agencies are not stringent on training, fit, and maintenance

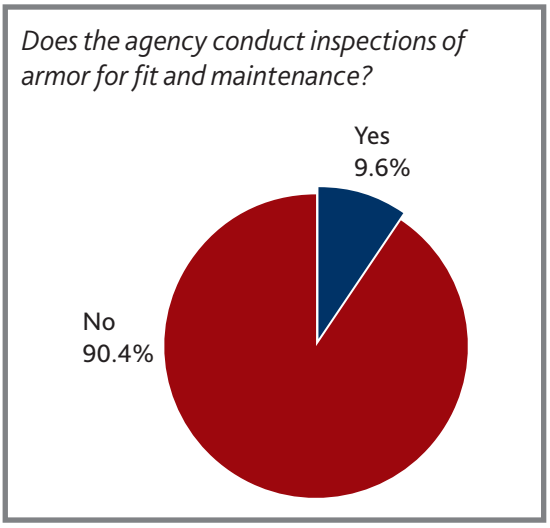

Figure 10. Agency inspection and maintenance of body armor

30 It should be noted that due to space limitations on the survey we did not query the respondents on the nature of their testing procedures. It is possible that some of the agencies conducted fairly rudimentary testing that would not qualify as scientific testing.

issues related to body armor use. Specifically, the vast majority of agencies rely on the manufacturer training and manuals for officer education regarding the benefits and limitations of body armor, as well as the fit and maintenance. Some departments have their own personnel conduct training, but others leave it to the individual officer to access the manufacturer materials. Agencies are even less stringent about maintenance, with the overwhelming majority not inspecting body armor to ensure proper fit or maintenance. Additionally, the vast majority of agencies have no automated system to schedule body armor replacement.

Our findings in this section are somewhat puzzling. For example, it is unclear why 10 percent of all state and local law enforcement agencies would not immediately replace and cover the replacement costs for armor that was damaged due to an assault against an officer. It may be that, given that there are few guidelines on body armor maintenance and limited information about the degradation of body armor over time, law enforcement officials believe they have little cause for concern about maintenance and replacement scheduling. As more research is conducted in the area of body armor degradation, maintenance policies may be more stringently applied and followed.

Finally, respondents were asked to indicate the types of changes they would like to see in future body armor. Most commonly, respondents indicated that they would like to see body armor that is more comfortable, weighs less, and offers increased threat protection.

Results for key questions by size of department

This section of the report will explore the differences in responses according to the differences in agencies' size (broken down as follows: agencies with 1–25 officers, 26–49 officers, 50–99 officers, 100–499 officers, and 500 or more officers). We are concerned that by not breaking down our results by agency size

Table 14. If an officer's body armor is damaged in a shooting or stabbing, or if the body armor is otherwise damaged during the course of service, is it automatically replaced?

Damaged body armor replaced?	Percentage of agencies
Yes	87.1%
No	12.9%
Don't know	0.1%

Table 15. If YES, does the agency cover the replacement costs?

Agency cover replacement cost?	Percentage of agencies
Yes	98.6%
No	1.4%

we might be masking some important patterns in our data. Also, this will allow agencies (from a given sized department) to compare their situation to jurisdictions of similar size. Table 16 contains a breakdown of agencies in the sample by number of sworn officers (weighted percentages and unweighted sample sizes are included[31]). The agencies that make up the largest part of our sample are those with 1–25 officers, as these agencies are the most common size in the United States.

As mentioned above, the vast majority of agencies, irrespective of size, indicated that their officers currently use body armor/bullet-resistant vests (as measured by the number of sworn officers). However, of those that reported that they do not currently use body armor, all were among the very smallest of the departments (with 1–25 sworn officers). Additionally, most departments of varying sizes (71.9 percent) do not currently use Zylon®-based body armor. Those departments that do use Zylon®-based body armor (8.1 percent) are spread across the spectrum of departments with regard to size; however, the smallest departments (of 1–25 officers) are more likely than others to still be using Zylon®-based armor (79.0 percent).

Little variation was found according to department size for most of Table 17. For patrol officers and members of tactical teams, mandatory wear policies were found at high levels in departments of all sizes. But for chiefs, sheriffs, and their command staff personnel, some variation was found, with the smallest and largest departments more likely than medium-size departments to have mandatory wear policies.

We also looked at variation in shootings and edged weapon assaults against officers according to department size (see Figures A–C in Appendix D). However, given the small sample sizes, as the number of incidents is so small, the data are presented in this report for descriptive purposes, and should not be used for drawing inferences. As mentioned above, the vast majority of agencies reported having had no officers assaulted with an

Table 16. Breakdown of number of sworn officers, weighted percentage and unweighted sample size

Category of agency	Weighted percentage of sample	Unweighted number
Agencies with 1–25 officers	68.8%	186
Agencies with 26–49 officers	16.5%	131
Agencies with 50–99 officers	7.4%	158
Agencies with 100–499 officers	6.2%	177
Agencies with 500+ officers	1.0%	128
Missing number of sworn officer information	0.1%	2

31 The unweighted number is the actual number of agencies in our sample that responded to a particular item and weighted percentage is the estimated percentage of the population of agencies in all of local and state law enforcement in the U.S. that responded to a survey item.

edged weapon. Twenty percent of agencies with 500 or more officers reported an assault of this nature, while only 4 percent of the smallest agencies reported such an assault. Of the departments that reported one or more assaults with an edged weapon, almost all were assaulted in an area not protected by body armor. Of those departments that reported having at least one officer cut in an area protected by body armor, all officers survived the incident.

The results, as expected showed that for the number of shootings that did occur, a greater percentage of the larger departments (those with 100 or more officers) had more officer shootings reported than smaller departments (fewer than 100 officers).

As would be expected, the likelihood of a police department suffering the fatal shooting of an officer increases with the size of the department (see Figure 11)—not only because the number of officers is increasing, but probably also because big cities present more crime threats than do small towns. The only departments that reported an officer killed after having been shot in an area of the body that was covered by body armor were those with 500 or more officers (50.0 percent). Of these departments, two reported having an officer shot and killed as a result of body armor failure.

The majority of departments indicated that their officers are fitted for their body armor. Police agency personnel, manufacturer representatives, or both do this fitting. Regardless of department size, most departments indicated that most commonly, manufacturer representatives fit their officers for their body armor (See Table 18). However, only agencies with less than 50 officers do have officers that receive body armor that approximates their size (as opposed to a personal fitting).

Table 17. Weighted percentage of personnel with mandatory wear policies

Category of personnel	1–25 officers	26–49 officers	50–99 officers	100–499 officers	500+ officers
Recruits	88.2%	84.1%	71.9%	75.0%	60.0%
Patrol officers	94.7%	85.9%	83.8%	86.4%	80.0%
Detectives/ plain clothes	35.8%	27.1%	13.9%	26.1%	20.0%
Tactical teams	84.2%	86.7%	84.8%	87.0%	80.0%
Undercover/ "old" clothes	40.0%	39.7%	12.5%	18.2%	20.0%
Command staff (excluding chiefs/sheriffs)	55.5%	42.9%	27.0%	26.1%	40.0%
Chief/Sheriff	36.7%	34.3%	22.2%	21.7%	40.0%

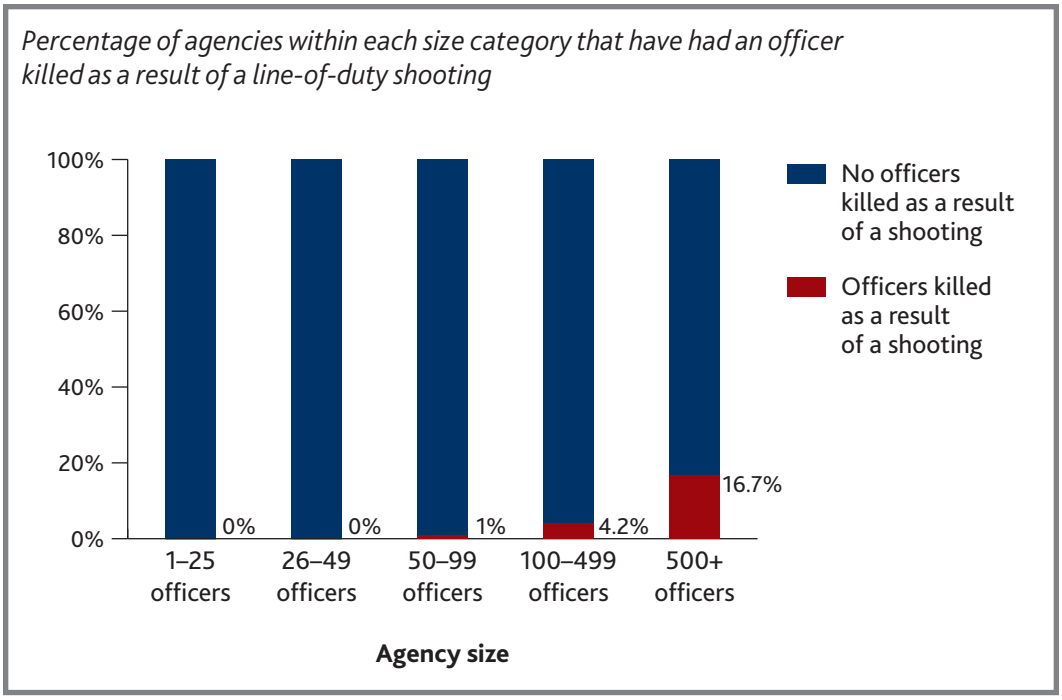

Figure 11. Weighted percentage of officers killed as a result of a shooting

Table 18. Are officers fitted for their body armor (weighted percentages)?

Fitted for body armor?	1–25 officers	26–49 officers	50–99 officers	100–499 officers	500+ officers
No, officers receive body armor that approximates their size	17.0%	1.6%	0.0%	0.0%	0.0%
Yes, officers are fitted by representatives from the manufacturer	67.4%	91.3%	86.2%	87.5%	75.0%
Yes, officers are fitted by police agency representatives	13.0%	4.7%%	10.3%	6.3%	12.5%
Yes, officers are fitted by manufacturer AND agency representatives	2.7%%	2.4%	3.4%	6.3%	12.5%

Conclusion

This study, conducted by PERF and in partnership with BJA, is one of the first to explore law enforcement agency policies and practices regarding the use of body armor, the types of body armor agencies typically use, the fit and maintenance of body armor, and officer lives saved related to the use of body armor. This survey project is important. Despite the fact that the law enforcement community has been using body armor for more than 30 years to reduce officer deaths and injuries, very little independent research data has been collected about agency-wide policies and practices regarding body armor. Our methodology was sound, including a large nationally representative sample of law enforcement agencies (n= 782) from across the United States. Also, our survey response rate was reasonably high (80 percent).

Our first main finding was that almost all law enforcement agencies (99.4 percent) from across the country report that their officers wear body armor when on duty. Next, while it is not a requirement of many law enforcement agencies (41 percent do not *require* their officers to wear body armor), it is encouraging that almost all agencies do provide fiscal support/ resources to ensure their officers wear body armor. Our survey findings suggest an overall move by agencies towards promoting the wearing of body armor and providing the necessary resources to do so. As a result of these policies, officers are probably more likely to be wearing body armor while assaulted in the line of duty, and the number of officer deaths is lower than it otherwise would be. These findings are consistent with those reported in the Bureau of Justice Statistics' Law Enforcement Management and Administrative Statistics (LEMAS) surveys, the latest of which was conducted in 2003, which reported that just under half of the law enforcement agencies had a mandatory wear policy but over 90 percent provide the armor or some form of cash/ reimbursement. LEMAS did report that this had not changed very much over the last six years, and our survey results are consistent with that finding. Also, while most agencies do encourage the wearing of body armor, most do not have stringent fit and maintenance policies. And in fact, agencies' maintenance of body armor is limited, and most do not conduct inspections of armor to ensure proper fit and maintenance.

While our study provides a broad descriptive look at policy and practices regarding law enforcement use of body armor, there are a number of areas that require further investigation. First, while nearly all agencies in the survey indicated that their officers currently use body armor, only a bit more than half indicated that they *require* their officers to wear body armor. The reasons why officers are not required to wear body armor were not explored in the survey, and would be an area for future research to explore. Also, future research could explore what proportions of officers actually wear body armor through direct surveys or interviews with officers on their use patterns with body armor.

The survey indicated that the primary factors that law enforcement agencies consider when purchasing body armor are whether the armor will defend against rounds from the service weapon of the officer, the safety level of the armor, and compliance with NIJ standards. However, the comfort of the body armor ranked nearly as high as those safety factors. These results suggest more debate and research is needed in the field about the protection versus comfort issue, for some have speculated that the earlier cited Zylon®-based body armor might have failed due to a design that placed too much emphasis on comfort over protection.

Next, more research is needed on the reported possible body armor failures from our study. Such a study could explore whether the reported failures were due to the limited stopping power of the vest used, the type of weapon used against the officer, or failure of the body armor fabric. Such a future study could also include the forensic investigation of a sample of used body armor that failed. Related to this issue is that little is also known about the effects of environmental exposure on body armor (e.g., ultra-violet light, humidity, and moisture), how it may degrade body armor over time, and how that might contribute to body armor failure.

Next, investigation into differences between agencies that do have mandatory wear policies versus those that do not, in terms of officer safety outcomes, is an area for future research. It would also be fruitful to conduct a deeper investigation focusing on the issue of permanent injury or disability as it relates to the use of body armor by officers. Injury is a significant concern for law enforcement. As LEOKA data show, 566,500 officers were assaulted from 1995 to 2004, with 165,400 injured, including 19,400 assaulted with a firearm. An important question is whether the use of body armor results in fewer officer injuries. The answer to that question could help guide agencies' body armor policies, given that officer disability and injury are costly to most agencies and cities. Much of the UCR/LEOKA data and the IACP/DuPont Kevlar Survivors' Club® data emphasizes officer deaths, but fails to explore the issue of officer injury or disability. These data sources need to consider more closely the role that body armor plays in mitigating injury, and whether injured or disabled officers were using body armor at the time they were injured.

While the existing policies that are adopted by the majority of law enforcement agencies seem to be successful for the moment, in terms of high officer armor usage, recent turbulent trends in officer deaths and nationwide violent crime show that agencies cannot be complacent in the long term. The FBI has reported that for 2006, 43 percent or 20 of the 46 officers feloniously killed by gunfire were *not* wearing body armor. However, by 2007 the percentage of officers feloniously killed by gunfire not wearing body armor dropped to 27 percent. While this is encouraging, given the turbulent nature of the policing environment and dramatic variation over the past couple of years in the number of officers killed in the line of duty, this is not a time for complacency. There may soon be a need for a nationwide effort to encourage agencies to revisit their body armor wear policies to increase their comprehensiveness and stringency.

Finally, as we learn more about the degradation of body armor over time, there needs to be a nationwide effort to address agencies' armor maintenance policies and practices, which are currently quite minimal. Also, as research progresses in obtaining more information about the types of weapons used in crimes, the types of armor commonly used, and the level of body armor necessary to protect against these newer threats, this new information should be taken into account as agencies consider modifying policy and training needs.

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APPENDIX A:
Summary of Key Body Armor Policy Studies

Research Study	Year	Description and Findings
Illinois Officers Body Armor Use (Illinois Department of Law Enforcement)	1979	A survey of 1,886 law enforcement officers across Illinois aimed to ascertain officer preference, effectiveness, availability, and cost of body armor. The survey found an overwhelming (87 percent) preference for the soft, undergarment type of body armor, but a clear lack of desire (75 percent) for a policy that mandates the wearing of such armor. Recommendations included not publicizing the purchase of body armor for law enforcement officers, purchasing the soft type of body armor for all department officers, and providing for periodic testing of all types of soft body armor manufactured; purchasing a sufficient number of hard body armor for use in specific situations; and establishing a policy encouraging but not mandating the use of body armor.
DuPont and NIJ studies on the effects of aging on body armor	1983 and 1986	A study of the ballistic-resistant capabilities of body armor used for extended periods of time was initiated in 1983 by DuPont (at which time some of the armor tested had been in service for more than 8 years). Both the DuPont testing and a 1986 study by NIJ (Frank, 1986) found that age alone does not degrade the ballistic properties of armor. Body armor manufactured in 1975 that remained in inventory without issue exhibited ballistic-resistant properties identical to those at the time of manufacture (Frank, 1986). Both research studies included armor that had been in use for as long as 10 years and that had ballistic properties that were indistinguishable from those of unused armor manufactured at the same time. NIJ tests failed to demonstrate any significant differences in 10-year-old armor, regardless of the extent of use or apparent physical condition.

Research Study	Year	Description and Findings
NIJ studies into testing ballistic efficiency of armor and factors that affect body armor degradation: storage, light, moisture, heart, maintenance, hours worn, and the user's physical activity.	2001–2004	The research largely focused on the use of Zylon®-based vests. Ballistic and mechanical property testing was conducted on 103 used vests containing Zylon® from U.S. law enforcement agencies. Of these, 60 were penetrated by at least one round in a six-shot test series. Of the armor not penetrated, 91 percent had backface deformations in excess of the NIJ standard. Testers also found no correlation between the level of visible wear of the body armor panels and the ballistic performance of those panels. Finally, the NIJ report concluded that ballistic-resistant material, including Zylon®, could degrade due to environmental factors. Specifically, the tensile strength of single yarns removed from the rear panel of the Forest Hills armor case was up to 30 percent lower than that of yarns from new armor supplied by the manufacturer. The NIJ report suggests that the ballistic performance degradation in Zylon®-containing armors is closely related to chemical changes in poly-*p*-phenylene benzobisoxazole (PBO), the chemical basis of Zylon® fiber. Preliminary investigations into Zylon® degradation mechanisms have suggested that degradation of Zylon® fibers may occur in the presence of external moisture.
PERF study of Zylon® Body Armor Use	2005	The study explored the 100 largest police agencies' use of Zylon®-based vests after the Zylon® failure that led to NIJ's Body Armor Standard Advisory Notice #01-2005. The study found that while almost all agencies were aware of this advisory, more than one-third still used body armor partly or entirely composed of Zylon® with a plan to replace their Zylon®-based vests, and the remainder planned an immediate replacement or were working with manufacturers to effect replacements. Most of the agencies that ceased using this type of body armor did so due to general uncertainty with the product, or because of reports highlighting failures of these vests; 17 percent of these respondents indicated that they stopped using Zylon®-based body armor due to the NIJ Advisory Notice.

Research Study	Year	Description and Findings
Study of body armor policies in small rural police and sheriff agencies (Eastern Kentucky University, Rose and Corner)	2006	100 small and rural police and sheriff agencies in all 50 states responded to a body armor survey. 89 percent of agencies reported having body armor available to all personnel, 7 percent provided armor for some personnel, and 4 percent do not have it available. Cost was the reason for those agencies with little or no armor. Of the agencies that used body armor, 6 percent required their personnel to purchase their own body armor, while 94 percent provided it. 62 percent had a written policy requiring personnel to wear body armor at all times, while 38 percent did not have a written policy. Ballistic capability and coverage were reported to be the most important consideration when agencies purchase body armor, followed closely by comfort, flexibility, and weight. 56 agencies indicated they intended to purchase different body armor in the future, while 44 agencies indicated that they did not have future purchasing plans. Agencies were also asked to rate the importance body armor technologies compared to other technology needs. Body armor technology was rated as one of their most important needs by 58 percent of the sample, a moderately important need by 38 percent, and a need of small or no importance by 4 percent.

APPENDIX B:
BJA Bullet Resistant Body Armor National Survey

POLICE EXECUTIVE RESEARCH FORUM

BJA BODY ARMOR SURVEY

ID NUMBER

The Police Executive Research Forum (PERF), with funding by the U.S. Department of Justice (DOJ) Bureau of Justice Assistance (BJA), is conducting a survey on the use of body armor by law enforcement agencies. This body armor survey will obtain critical information pertaining to policies and practices of agencies, the types of body armor agencies typically use, the fit and maintenance of body armor, and officer lives saved related to the use of body armor.

Your participation is vital to our goal of achieving as close to a 100 percent response rate as possible. Thus, although your participation is voluntary, our receipt of your completed survey is critical to the achievement of our goals.

There are three ways to respond to this survey:

1. Internet: An electronic version of this questionnaire is located on the Internet at http://survey.policeforum.org/BJAbodyarmorsurvey.pdf. If you choose to complete the survey via the Internet, you will be prompted to enter the following information:

   USER NAME: bodyarmor
   PASSWORD: bjasurvey
   ID NUMBER:

   Without entering your agency's user name, password, and ID number, you will not be able to complete the survey online. The user name and password provide a secure location to submit your survey.

2. Fax the completed survey to the Police Executive Research Forum at (202) 466-7826.
3. Mail the completed survey using the enclosed self-addressed envelope:

   Bruce Kubu
   Police Executive Research Forum
   1120 Connecticut Avenue, NW, Suite 930
   Washington, DC 20036

If you have any questions regarding this project, please feel free to contact Kristin Kappelman at (202) 454-8320 or kkappelman@policeforum.org. Thank you for your time and assistance.

Respondent Contact Information:

Agency

Title

Last Name

First Name

Email Address

Telephone ( ) – **Ext.**

POLICE EXECUTIVE RESEARCH FORUM

ID NUMBER

BJA BODY ARMOR SURVEY

DEPARTMENT CHARACTERISTICS

1. **Please provide the following characteristics about your agency:**

   Number of Total Personnel: ☐☐☐☐☐

   Number of Sworn Personnel (all ranks): ☐☐☐☐☐

   Number of Sworn Patrol Personnel (all ranks): ☐☐☐☐☐

   Service Population of Jurisdiction: ☐☐☐☐☐☐☐☐

2. **What caliber sidearm does your agency issue to patrol officers or authorize for their use/purchase? Please mark all that apply.**
   - ☐ 9 mm
   - ☐ 10 mm
   - ☐ .22 caliber
   - ☐ .357
   - ☐ .380
   - ☐ .38
   - ☐ .40
   - ☐ .45
   - ☐ Other, please specify: _____

3. **What type of secondary firearms systems does your agency issue to patrol officers or authorize for their use/purchase? Please mark all that apply.**
   - ☐ AR-15
   - ☐ Shotgun
   - ☐ Carbine
   - ☐ Rifle
   - ☐ Other, please specify: _____
   - ☐ Not applicable--no secondary firearms systems authorized

4. **For each of the less-lethal weapons listed below, please indicate which weapons are currently issued to patrol officers or are authorized for their use/purchase. Please mark all that apply.**
   - ☐ Straight or side-handle baton
   - ☐ Expandable baton (e.g., Asp)
   - ☐ Conducted energy device (e.g., Taser, stun gun)
   - ☐ Personal issue (i.e., handheld) chemical agents (e.g., OC, CS)
   - ☐ Weapon-deployed chemical agent (e.g., pepper ball)
   - ☐ Other impact munitions (e.g., soft projectiles, rubber bullets, bean bags)
   - ☐ Other, please specify: _____
   - ☐ Not applicable--no less-lethal weapons authorized

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BODY ARMOR

5. **Do your officers currently use body armor/bullet-resistant vests?**
   - ☐ No (STOP HERE AND PLEASE RETURN THE SURVEY TO PERF. IF COMPLETING THE SURVEY ONLINE, PLEASE SCROLL DOWN TO THE LAST PAGE AND HIT THE "SUBMIT" BUTTON.)
   - ☐ Yes
6. **Are any of your officers currently wearing body armor that is ENTIRELY, or PARTLY, composed of Zylon[1]?**
   - ☐ No **[Skip to Question 8]**
   - ☐ Yes
   - ☐ Don't know
7. **If yes, does your agency plan to replace its Zylon-based body armor?**
   - ☐ No ➔ **If no, why not?**
   - ☐ Yes ➔ **If yes, with what body armor will you replace your Zylon-based body armor?**
   - ☐ Don't know **[Skip to Question 8]**

7a. If YES, how will your agency handle the replacement costs of the Zylon-based body armor? Please mark all that apply.

- ☐ Existing budget
- ☐ Seizure/asset forfeiture funds
- ☐ External federal funds, please specify:
- ☐ External city/local/state funds
- ☐ Private funding
- ☐ Exchange with manufacturer or supplier
- ☐ Funds not available
- ☐ To be determined
- ☐ Other, please specify:

[1] **Zylon (PBO fiber - poly-p-phenylene benzobiasoxazole) is a high strength organic fiber produced by Toyobo Co., Ltd. Zylon is a registered trademark of the Toyobo Co., Ltd.**

9. **In the past five years, how many officers from your agency died in the line of duty as a result of an edged weapon attack?**

POLICE EXECUTIVE RESEARCH FORUM

BJA BODY ARMOR SURVEY

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8. **Does your agency REQUIRE its officers to wear body armor?**
   - ☐ No
   - ☐ Yes

9. **Does your agency have a written policy requiring your officers to wear body armor?**
   - ☐ No **[Skip to Question 11]**
   - ☐ Yes ➔ **Please fill out the following table by marking the policy for each category of personnel. Please mark only ONE response per category.**

	Mandatory by policy with no exceptions (i.e., required at all times when on duty)	Mandatory by policy with exceptions (e.g., not required when working at headquarters)	Not mandatory but required under special circumstances (e.g., when serving a warrant)	Not mandatory (i.e., officer's discretion)	Not applicable - no such category of personnel
Recruits	☐	☐	☐	☐	☐
Patrol officers	☐	☐	☐	☐	☐
Detectives/ Plain clothes	☐	☐	☐	☐	☐
Tactical teams	☐	☐	☐	☐	☐
Undercover officers/ "Old" clothes	☐	☐	☐	☐	☐
Command staff (excluding Chiefs/Sheriffs)	☐	☐	☐	☐	☐
Chief/Sheriff	☐	☐	☐	☐	☐
Other, please specify:	☐	☐	☐	☐	☐

Additional comments for Question 9:

10. **What is your agency's disciplinary policy when an officer does not wear body armor when required to do so? Please mark all that apply.**
    - ☐ Suspension
    - ☐ Written reprimand
    - ☐ Verbal reprimand
    - ☐ Fine
    - ☐ Termination
    - ☐ Policy is not enforced
    - ☐ Other, please specify:

POLICE EXECUTIVE RESEARCH FORUM

BJA BODY ARMOR SURVEY

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11. Does your agency currently issue body armor OR is it up to the individual officer to purchase his/her own body armor?

11a. Does your agency issue body armor? ☐ Yes ☐ No ☐ Don't know

Number issued by agency: ☐☐☐☐☐

11b. Do your officers purchase their body armor? ☐ Yes ☐ No ☐ Don't know

Number purchased by officers: ☐☐☐☐☐

If YES, does the officer receive reimbursement? ☐ Yes ☐ No ☐ Don't know

If YES, is the reimbursement full or partial? ☐ Full ☐ Partial → ☐☐☐ % Partial Reimbursement

12. Does your agency currently issue trauma/ballistic plates OR is it up to the individual officer to purchase his/her own trauma plates?

12a. Does your agency issue trauma plates? ☐ Yes ☐ No ☐ Don't know

Number issued by agency: ☐☐☐☐☐

12b. Do your officers purchase their trauma plates? ☐ Yes ☐ No ☐ Don't know

Number purchased by officers: ☐☐☐☐☐

If YES, does the officer receive reimbursement? ☐ Yes ☐ No ☐ Don't know

If YES, is the reimbursement full or partial? ☐ Full ☐ Partial → ☐☐☐ % Partial Reimbursement

13. Please indicate, by brand of body armor and threat level, all personnel who wear body armor at least part of the time while on duty. Please mark all that apply.

	Level I	Level II-A	Level II	Level III-A	Level III	Level IV
American Body Armor	☐ Recruit ☐ Patrol ☐ Detective ☐ Tactical ☐ Command ☐ Chief/Sheriff ☐ Undercover ☐ Other	☐ Recruit ☐ Patrol ☐ Detective ☐ Tactical ☐ Command ☐ Chief/Sheriff ☐ Undercover ☐ Other	☐ Recruit ☐ Patrol ☐ Detective ☐ Tactical ☐ Command ☐ Chief/Sheriff ☐ Undercover ☐ Other	☐ Recruit ☐ Patrol ☐ Detective ☐ Tactical ☐ Command ☐ Chief/Sheriff ☐ Undercover ☐ Other	☐ Recruit ☐ Patrol ☐ Detective ☐ Tactical ☐ Command ☐ Chief/Sheriff ☐ Undercover ☐ Other	☐ Recruit ☐ Patrol ☐ Detective ☐ Tactical ☐ Command ☐ Chief/Sheriff ☐ Undercover ☐ Other
Point Blank Body Armor	☐ Recruit ☐ Patrol ☐ Detective ☐ Tactical ☐ Command ☐ Chief/Sheriff ☐ Undercover ☐ Other	☐ Recruit ☐ Patrol ☐ Detective ☐ Tactical ☐ Command ☐ Chief/Sheriff ☐ Undercover ☐ Other	☐ Recruit ☐ Patrol ☐ Detective ☐ Tactical ☐ Command ☐ Chief/Sheriff ☐ Undercover ☐ Other	☐ Recruit ☐ Patrol ☐ Detective ☐ Tactical ☐ Command ☐ Chief/Sheriff ☐ Undercover ☐ Other	☐ Recruit ☐ Patrol ☐ Detective ☐ Tactical ☐ Command ☐ Chief/Sheriff ☐ Undercover ☐ Other	☐ Recruit ☐ Patrol ☐ Detective ☐ Tactical ☐ Command ☐ Chief/Sheriff ☐ Undercover ☐ Other

↳ Question continues on the next page.

Police Executive Research Forum

BJA BODY ARMOR SURVEY

ID NUMBER

Question 13 CONTINUED from previous page...

13. Please indicate, by brand of body armor and threat level, all personnel who wear body armor at least part of the time while on duty. Please mark all that apply.

	Level I	Level II-A	Level II	Level III-A	Level III	Level IV
Protective Apparel Corporation of America (PACA)	☐ Recruit ☐ Patrol ☐ Detective ☐ Tactical ☐ Command ☐ Chief/Sheriff ☐ Undercover ☐ Other	☐ Recruit ☐ Patrol ☐ Detective ☐ Tactical ☐ Command ☐ Chief/Sheriff ☐ Undercover ☐ Other	☐ Recruit ☐ Patrol ☐ Detective ☐ Tactical ☐ Command ☐ Chief/Sheriff ☐ Undercover ☐ Other	☐ Recruit ☐ Patrol ☐ Detective ☐ Tactical ☐ Command ☐ Chief/Sheriff ☐ Undercover ☐ Other	☐ Recruit ☐ Patrol ☐ Detective ☐ Tactical ☐ Command ☐ Chief/Sheriff ☐ Undercover ☐ Other	☐ Recruit ☐ Patrol ☐ Detective ☐ Tactical ☐ Command ☐ Chief/Sheriff ☐ Undercover ☐ Other
Safariland	☐ Recruit ☐ Patrol ☐ Detective ☐ Tactical ☐ Command ☐ Chief/Sheriff ☐ Undercover ☐ Other	☐ Recruit ☐ Patrol ☐ Detective ☐ Tactical ☐ Command ☐ Chief/Sheriff ☐ Undercover ☐ Other	☐ Recruit ☐ Patrol ☐ Detective ☐ Tactical ☐ Command ☐ Chief/Sheriff ☐ Undercover ☐ Other	☐ Recruit ☐ Patrol ☐ Detective ☐ Tactical ☐ Command ☐ Chief/Sheriff ☐ Undercover ☐ Other	☐ Recruit ☐ Patrol ☐ Detective ☐ Tactical ☐ Command ☐ Chief/Sheriff ☐ Undercover ☐ Other	☐ Recruit ☐ Patrol ☐ Detective ☐ Tactical ☐ Command ☐ Chief/Sheriff ☐ Undercover ☐ Other
Second Chance	☐ Recruit ☐ Patrol ☐ Detective ☐ Tactical ☐ Command ☐ Chief/Sheriff ☐ Undercover ☐ Other	☐ Recruit ☐ Patrol ☐ Detective ☐ Tactical ☐ Command ☐ Chief/Sheriff ☐ Undercover ☐ Other	☐ Recruit ☐ Patrol ☐ Detective ☐ Tactical ☐ Command ☐ Chief/Sheriff ☐ Undercover ☐ Other	☐ Recruit ☐ Patrol ☐ Detective ☐ Tactical ☐ Command ☐ Chief/Sheriff ☐ Undercover ☐ Other	☐ Recruit ☐ Patrol ☐ Detective ☐ Tactical ☐ Command ☐ Chief/Sheriff ☐ Undercover ☐ Other	☐ Recruit ☐ Patrol ☐ Detective ☐ Tactical ☐ Command ☐ Chief/Sheriff ☐ Undercover ☐ Other
US Armor	☐ Recruit ☐ Patrol ☐ Detective ☐ Tactical ☐ Command ☐ Chief/Sheriff ☐ Undercover ☐ Other	☐ Recruit ☐ Patrol ☐ Detective ☐ Tactical ☐ Command ☐ Chief/Sheriff ☐ Undercover ☐ Other	☐ Recruit ☐ Patrol ☐ Detective ☐ Tactical ☐ Command ☐ Chief/Sheriff ☐ Undercover ☐ Other	☐ Recruit ☐ Patrol ☐ Detective ☐ Tactical ☐ Command ☐ Chief/Sheriff ☐ Undercover ☐ Other	☐ Recruit ☐ Patrol ☐ Detective ☐ Tactical ☐ Command ☐ Chief/Sheriff ☐ Undercover ☐ Other	☐ Recruit ☐ Patrol ☐ Detective ☐ Tactical ☐ Command ☐ Chief/Sheriff ☐ Undercover ☐ Other
Other, please specify:	☐ Recruit ☐ Patrol ☐ Detective ☐ Tactical ☐ Command ☐ Chief/Sheriff ☐ Undercover ☐ Other	☐ Recruit ☐ Patrol ☐ Detective ☐ Tactical ☐ Command ☐ Chief/Sheriff ☐ Undercover ☐ Other	☐ Recruit ☐ Patrol ☐ Detective ☐ Tactical ☐ Command ☐ Chief/Sheriff ☐ Undercover ☐ Other	☐ Recruit ☐ Patrol ☐ Detective ☐ Tactical ☐ Command ☐ Chief/Sheriff ☐ Undercover ☐ Other	☐ Recruit ☐ Patrol ☐ Detective ☐ Tactical ☐ Command ☐ Chief/Sheriff ☐ Undercover ☐ Other	☐ Recruit ☐ Patrol ☐ Detective ☐ Tactical ☐ Command ☐ Chief/Sheriff ☐ Undercover ☐ Other

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BJA BODY ARMOR SURVEY

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14. **Does your agency use internal or external carriers for your body armor?**
    - ☐ Internal (i.e., officer wears body armor under uniform shirt)
    - ☐ External (i.e., officer wears body armor over uniform shirt)
    - ☐ Both

OFFICER INJURIES AND DEATHS

Edged Weapons

15. **In the past five years, how many officers from your agency were assaulted in the line of duty by suspects using edged weapons (e.g., a knife)? If none, enter 0 and skip to Question 17.**

    ☐☐☐☐ **Officers**

    15a. **Of these officers, how many were stabbed or cut in an area covered by body armor? If none, enter 0 and skip to Question 16.**

    ☐☐☐☐ **Officers**

    15b. **Of these officers stabbed or cut in an area covered by body armor, how many survived the incident?**

    ☐☐☐☐ **Officers**

16. **In the past five years, how many officers from your agency died in the line of duty as a result of an edged weapon attack?**

    ☐☐☐☐ **Officers**

Firearm Shootings

17. **In the past five years, how many officers from your agency were shot in the line of duty?**

    ☐☐☐☐ **Officers**

18. **In the past five years, how many officers from your agency were shot but not killed while on duty?**

    ☐☐☐☐ **Officers**

    18a. **Of these officers, how many were shot in an area covered by body armor?**

    ☐☐☐☐ **Officers**

POLICE EXECUTIVE RESEARCH FORUM

BJA BODY ARMOR SURVEY

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Firearm Deaths

19. In the past five years, how many officers from your agency died as a result of an injury from a gun shot wound suffered in the line of duty?

☐☐☐☐ Officers

19a. Of these officers, how many were shot in an area covered by body armor?

☐☐☐☐ Officers

19b. How many of these officers who were shot in an area covered by body armor died as a result of a possible body armor failure (i.e., the bullet went through the vest or the vest did not protect the officer from the blunt trauma that in turn killed the officer)? Do not count cases in which officers were shot with a weapon that the body armor was not designed to protect against (e.g., rifle).

☐☐☐☐ Officers

PURCHASING

20. How does your agency acquire body armor? Please mark all that apply.

- ☐ Agency purchases new body armor
- ☐ Agency receives surplus/donated body armor
- ☐ Agency does not acquire body armor. Officers acquire body armor on their own.
- ☐ Other, please specify:
- ☐ Don't know

21. Does your agency engage in a competitive bidding process to acquire new body armor?

- ☐ Yes
- ☐ No, use existing contract vehicle
- ☐ No, not required to engage in a competitive bidding process
- ☐ No, use sole source process
- ☐ No, other reason, please specify:
- ☐ Don't know

22. Does your agency have specified standards for body armor performance?

- ☐ No
- ☐ Yes
- ☐ Don't know

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23. Based on your agency's policies and practices, please rate the importance of the following factors related to the purchasing of body armor. Rate each using a scale of 1 (very important) to 4 (not important).

	Very important			Not important	Don't know
Defeat rounds from officer's weapon	☐ 1	☐ 2	☐ 3	☐ 4	☐ Don't know
Safety/Threat level	☐ 1	☐ 2	☐ 3	☐ 4	☐ Don't know
Cost	☐ 1	☐ 2	☐ 3	☐ 4	☐ Don't know
Warranty	☐ 1	☐ 2	☐ 3	☐ 4	☐ Don't know
Comfort	☐ 1	☐ 2	☐ 3	☐ 4	☐ Don't know
Weight of body armor	☐ 1	☐ 2	☐ 3	☐ 4	☐ Don't know
Officers' ability to move	☐ 1	☐ 2	☐ 3	☐ 4	☐ Don't know
Confidence in name-brand	☐ 1	☐ 2	☐ 3	☐ 4	☐ Don't know
Collective bargaining interests	☐ 1	☐ 2	☐ 3	☐ 4	☐ Don't know
Referrals	☐ 1	☐ 2	☐ 3	☐ 4	☐ Don't know
Composition of body armor materials	☐ 1	☐ 2	☐ 3	☐ 4	☐ Don't know
Compliance with NIJ standard #01-2005	☐ 1	☐ 2	☐ 3	☐ 4	☐ Don't know
Services offered by the manufacturer	☐ 1	☐ 2	☐ 3	☐ 4	☐ Don't know
Input from officers	☐ 1	☐ 2	☐ 3	☐ 4	☐ Don't know
Other, please specify:	☐ 1	☐ 2	☐ 3	☐ 4	☐ Don't know

POLICE EXECUTIVE RESEARCH FORUM

BJA BODY ARMOR SURVEY

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24. Are officers fitted for their body armor? Please mark only one response.

- ☐ No, officers receive body armor that approximates their body size (e.g., small, medium, large, etc.) **[Skip to Question 25]**
- ☐ Yes, officers are fitted by representatives from the manufacturer/supplier
- ☐ Yes, officers are fitted by internal agency representatives
- ☐ Officers are fitted by manufacturer AND agency representatives

24a. If YES, does fitting take place at time of order?

- ☐ No
- ☐ Yes
- ☐ Don't know

24b. If YES, does an additional fitting occur upon delivery of body armor?

- ☐ No
- ☐ Yes
- ☐ Don't know

MAINTENANCE, TRAINING, AND INSPECTION

25. How does your agency educate/train its officers on the benefits and limitations of wearing body armor and on body armor care and maintenance? Please mark all that apply.

	Benefits and limitations of body armor	Body armor care and maintenance
Manufacturer-provided literature/manuals	☐	☐
Department-provided literature/manuals	☐	☐
Supervisory staff	☐	☐
Manufacturer/supplier representative	☐	☐
In-service/specialized training	☐	☐
Academy	☐	☐
Firearms training	☐	☐
Roll call	☐	☐
Other, please specify:	☐	☐
NONE PROVIDED	☐	☐

POLICE EXECUTIVE RESEARCH FORUM

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26. Does your agency conduct inspections to ensure that officers' body armor fit and/or are maintained properly?

☐ No **[Skip to Question 27]**

☐ Yes ➔ **Please describe how your inspectors are trained:**

26a. If YES, how often are body armor inspections conducted for fit and maintenance? Please mark one response for both "Fit" and "Maintenance".

	Fit	Maintenance
About once a week	☐	☐
A few times a month	☐	☐
About once a month	☐	☐
About once every 3 months	☐	☐
About once every 6 months	☐	☐
About once a year	☐	☐
Less than once a year	☐	☐
Other, please specify:	☐	☐

27. Does your agency have a database or automated record system for a body armor replacement schedule?

☐ No **[Skip to Question 28]**

☐ Yes

27a. If YES, are officers given early notification to ensure on-time replacement?

☐ No

☐ Yes

28. How often does your agency replace body armor?

☐ Every year
☐ Every 2 years
☐ Every 3 years
☐ Every 4 years
☐ Every 5 years
☐ Every 6 years
☐ Every 7 years
☐ Every 8 years
☐ Other, please specify:
☐ No policy on replacements
☐ No replacements offered
☐ Don't know

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29. **What does your agency do with used body armor (i.e., when an officer retires or receives new body armor)? Please mark all that apply.**
    - ☐ Body armor is thrown away by our agency
    - ☐ Body armor is destroyed
    - ☐ Manufacturer disposes of body armor
    - ☐ Body armor is put in patrol car doors
    - ☐ Body armor is kept for off-duty use
    - ☐ Body armor is donated/sold to other domestic law enforcement agencies
    - ☐ Body armor is sent to organizations in other countries
    - ☐ Body armor is given to civilians in the department
    - ☐ Other, please specify:

30. **If an officer's body armor is damaged in a shooting or stabbing, or if the body armor is otherwise damaged during the course of service, is it automatically replaced?**
    - ☐ No **[Skip to Question 31]**
    - ☐ Yes

    30a. If YES, does the agency cover the replacement costs?
    - ☐ No
    - ☐ Yes

31. **Does your agency have additional body armor available for emergencies or when an officer is awaiting new body armor?**
    - ☐ No
    - ☐ Yes

32. **Does your agency conduct testing on body armor to ensure that body armor functions properly by stopping rounds within its certified standards?**
    - ☐ No **[Skip to Question 33]**
    - ☐ Yes
    - ☐ Don't know

    32a. If YES, who conducts the testing?
    - ☐ Agency
    - ☐ Other, please specify:
    - ☐ Independent lab

33. **Does your agency collect information pertaining to the performance and durability of its body armor?**
    - ☐ No
    - ☐ Yes
    - ☐ Don't know

34. **What types of changes (e.g., weight/comfort, level of protection, fit, warranties, etc.) would you like to see in body armor?**

APPENDIX C: Technical Section on Sampling Methods

PERF contracted with Tailored Statistical Solutions, LLC (TSS) to draw a stratified nationally representative sample of municipal, county, and state law enforcement agencies (both police chiefs and sheriffs) that would receive the body armor survey. Specifically, a probability sampling approach was used, where every element of the population has a known probability of being included in the sample. Probability samples allow us to make probability statements about sample statistics and allow us to estimate the extent to which a sample statistic is likely to differ from a population parameter. The main benefit of this approach is that it guarantees that the sample chosen is representative of the population, ensuring that our statistical conclusions will be valid.

The sample was drawn from a census directory of the universe of U.S. state and local law enforcement agencies known as the 2006 National Directory of Law Enforcement Agencies (NDLEA) database. This database contained information on 16,100 law enforcement agencies from around the U.S.; these agencies were believed to be unique. In addition to executives' information, the NDLEA database includes population served, the number of officers and the region in which the agency is located. Five regions were defined in the database: Northeast, Southeast, South, Midwest, and West. We refer to these regions as NDLEA regions. In order to determine how many agencies to include in our sample, we conducted a power analysis using PASS 2004 software (Hintze, 2004). Our univariate survey results are tabulated as percentages with confidence intervals. Our sample size was 782, and statistical power is to estimate proportions to within Ⓟ 3.43 percent with a 95 percent confidence level.

Given the diversity of law enforcement agencies in the United States, it is advantageous to sample each subpopulation (stratum) independently. Stratification is the process of grouping members of the population into homogeneous subgroups before sampling. The strata are mutually exclusive and every element in the population is assigned to only one stratum. Stratification improves the representativeness of the sample by reducing sampling error, and allows the researchers to produce a weighted mean that has less variability than the arithmetic mean of a simple random sample of the population.

To assure that the research team had enough large agencies to analyze, we used a *disproportionate stratified sampling* approach (also known as "over-sampling"). Our first step was to divide all of the agencies from the NDLEA database into sub-groups known as strata and next sample separately per stratum. Crucially, the sampling fraction was not the same within all of our strata: the large agencies were over-sampled relative to others. To obtain unbiased estimates for our disproportionate stratified sample, our team weighted the survey estimates (also known as post-stratification or post hoc weighting). Post hoc stratification is a weighting method that adjusts for any differences between the survey data and the population in terms of

a few key population variables. The aim was to reduce any bias in the survey due to sampling error and/or non-response effects. The weights allow the analysis to be adjusted to represent the population better. We used special statistical weighting procedures when making tables of means, counts, percentages, or other survey statistics from data with weights. The calculation of the weight was fairly straightforward: it is simply the inverse of the sampling fraction used in the stratum. So, in a stratum where the sampling fraction is 1 in 10, all cases received a weight of 10; and in a stratum where the sampling fraction is 1 in 22, all cases received a weight of 22.

Defining the Strata

We used the following stratification variables: Number of sworn officers (very small= 1 – 24, small= 25 – 49, medium= 50 – 99, large= 100 – 499, and very large= 500 or more), geographic region (established by U.S. Census Bureau: Northeast, Midwest, South, and West), and population served by department (based on request under 10,000, 10,000 – 49,999, 50,000 – 99,999, 100,000 – 499,999, 500,000 – 999,999, and 1,000,000 or more). By using stratification to group similar units together, we reduce the variability within groups. It also allows for the identification of differences between groups. For instance, we would expect LEAs of similar size to have similar responses. We would not expect large LEAs to respond the same as very small LEAs.

Steps in Sampling Process

Due to their small number, we included the 49[32] State Police Departments in our sample as well. While the NDLEA database is a very accurate census of U.S. law enforcement, complete information is not always available for every variable. To address this issue TSS began by drawing a sample from those LEAs that did have complete information (this was conducted separately for police chiefs and sheriffs), specifically, region (Northeast, Midwest, South, and West), population served (number of residents in the community served) and agency size (number of officers). Secondly, TSS drew a sample from those LEAs (again conducted separately for police chiefs and sheriffs) where information on population served was not available, and therefore was just based on region and agency size. Then, TSS drew a sample from the LEAs (separately for police chiefs and sheriffs) where agency size information was not available, but had both region and population served data. Finally, TSS drew a sample from those LEAs (separately for police chiefs and sheriffs) where population served and agency size was not available, but just had region data available.

32 The State of Hawaii does not have a dedicated State Police Department.

APPENDIX D:
Detailed Tabular Results

Table I. In the past five years, how many officers from your agency were assaulted in the line of duty by suspects using edged weapons (e.g. a knife)?

Number of officers	Weighted percentage
0	93.7%
1	4.0%
2	1.4%
3	0.2%
4	0.2%
5	0.3%
6	0.2%
7	<0.1%
9	<0.1%
10	0.1%
11	<0.1%
12	<0.1%
13	<0.1%
24	<0.1%
25	<0.1%
37	<0.1%
107	<0.1%
127	<0.1%

Table II. In the past five years, how many officers from your agency were shot in the line of duty?

Number of officers	Weighted percentage
0	94.3%
1	4.5%
2	0.8%
3	0.1%
4	<0.1%
5	0.1%
6	<0.1%
7	<0.1%
8	<0.1%
10	<0.1%
11	<0.1%
13	<0.1%
15	<0.1%
18	<0.1%
22	<0.1%
35	<0.1%
61	<0.1%

Table III. Of these officers who were shot in the line of duty, how many were shot in an area of the body covered by body armor?

Number of officers	Weighted percentage
0	79.6%
1	15.8%
2	4.0%
3	0.3%
4	0.1%
5	0.1%

Table IV. Rate the importance of the following factors related to the purchasing of body armor. 1= very important to 4=not important.

Factor	Mean
Defeat rounds from officer's weapon	1.13
Safety/Threat level	1.15
Cost	2.12
Warranty	1.70
Comfort	1.38
Weight of body armor	1.48
Officers' ability to move	1.28
Confidence in name brand	1.84
Collective bargaining interests	3.07
Referrals	2.65
Composition of body armor	1.86
Compliance with NIJ standard #01-2005	1.29
Services offered by the manufacturer	1.89
Input from officers	1.64

Table V. Weighted percentage of officers assaulted with an edged weapon among the agency size categories

	Agencies with 1–25 officers	Agencies with 26–49 officers	Agencies with 50–99 officers	Agencies with 100–499 officers	Agencies with 500+ officers
Percentage of agencies within each category that report having officers assaulted with an edged weapon	4.0%	9.5%	7.2%	6.7%	20.0%

Table VI. Of those officers assaulted with an edged weapon, the weighted percentage of officers assaulted in an area of the body not covered by body armor

	1–25 officers	26–49 officers	50–99 officers	100–499 officers	500+ officers
Percentage of agencies within each category that report having officers assaulted with an edged weapon in an area not protected by body armor	18.2%	33.3%	0.0%	0.0%	0.0%

Table VII. Weighted percentage of officers shot but not killed in the line of duty

	Agencies with 1–25 officers	Agencies with 26–49 officers	Agencies with 50–99 officers	Agencies with 100–499 officers	Agencies with 500+ officers
Percentage of agencies within each category that report having had officers shot in the line of duty	2.9%	2.3%	15.8%	25.0%	60.0%

Table VIII. Of these officers, the weighted percentage of officers shot in an area covered by body armor

	1–25 officers	26–49 officers	50–99 officers	100–499 officers	500+ officers
Officers shot in the line of duty	7.7%	50.0%	50.0%	11.1%	50.0%

Table IX. Weighted percentage of officers killed as a result of a shooting

	1–25 officers	26–49 officers	50–99 officers	100–499 officers	500+ officers
Officers killed as a result of a shooting	0.0%	0.0%	1.8%	4.2%	16.7%

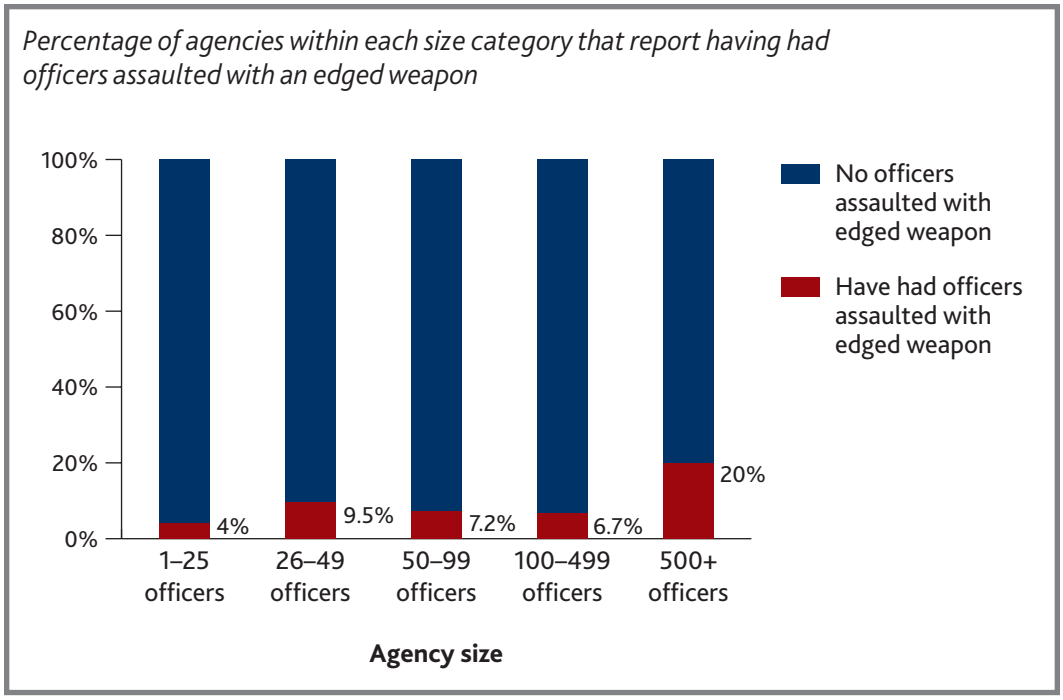

Figure A. Weighted percentage of officers assaulted with an edged weapon, by size of agency

Percentage of agencies within each size category whose edged weapon assaults to officers occurred in an area of the body covered/not covered by body armor

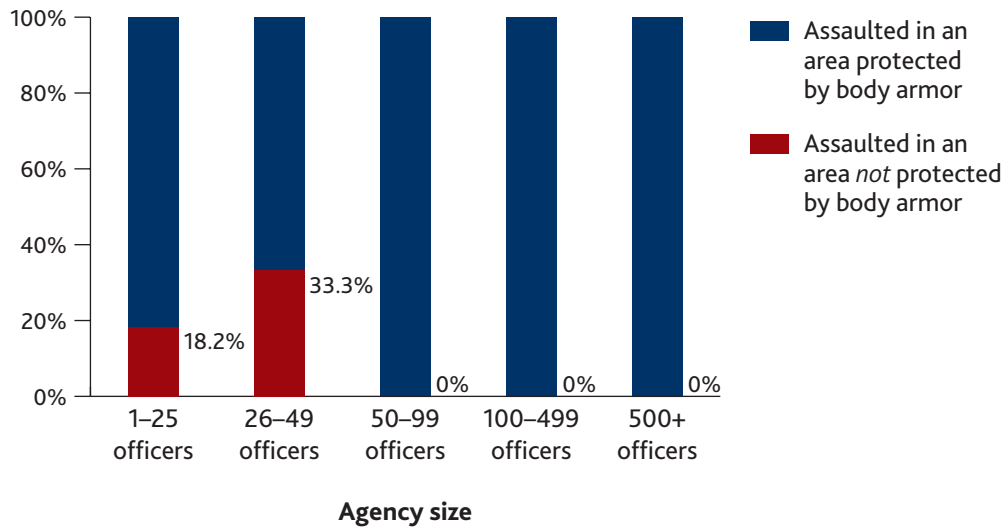

Figure B. Of those officers assaulted with an edged weapon, the weighted percentage of officers assaulted in an area of the body covered/not covered by body armor

Percentage of agencies within each size category that report having had officers shot in the line of duty

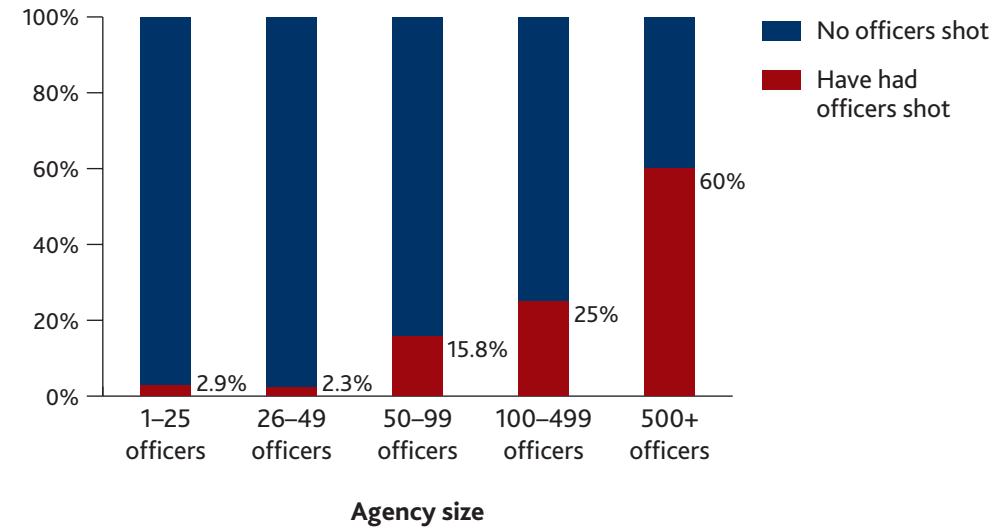

Figure C. Weighted percentage of officers shot but not killed in the line of duty

APPENDIX E: Research Methods

In this section, we review the methods used in our study. For a technical discussion of our sampling methodology, see "TECHNICAL APPENDIX C: Sampling Methods."

Survey Instrument

PERF developed the BJA Body Armor national survey with feedback from BJA. The process of creating and validating the instrument occurred in three stages. First, to guide the content development of the survey, PERF assembled a *Technical Advisory Group*[33] (*TAG*) of practitioner and academic experts. The TAG members were asked to provide input on the constructs to be included in the survey instrument and to help develop draft survey questions to measure those constructs. Information gathered from this discussion was used to draft the survey instrument. The project TAG ensured that the project incorporated the latest developments and national trends in body armor, while at the same time assuring its local applicability and relevance.

In the second stage of survey development, experienced PERF staff—researchers and former law enforcement practitioners—were called upon to review the draft instrument. A 15-member senior and mid-level PERF research team reviewed the document independently and then met to discuss any issues and suggest modifications. Attention was paid to both survey form and content. The project TAG also reviewed later drafts of the survey, focusing mostly on content-related issues.

In the third stage, PERF sent the draft survey to a dozen agencies for pilot testing. The participants were asked to complete the survey and provide feedback on the instrument. PERF staff conducted cognitive phone interviews with each respondent. Particular attention was paid to determining whether the respondents perceived the survey items as the project team intended.[34] Based upon feedback received from the internal PERF review, feedback from BJA staff, as well as pilot testing/cognitive interviews, PERF revised the survey instrument. All feedback gathered from the group was evaluated and changes were made to the survey as appropriate. The survey was then converted into Teleform, which is a software application owned by PERF that is

33 The Technical Advisory Group is made up of representatives from the National Institute of Justice, Fairfax County Police Department, San Antonio Police Department, Edmonton Police Service, Metropolitan D.C. Police Department, Prince George's County Police, Denver Police Department, Los Angeles Police Department, as well as several senior research staff from PERF.

34 That is, we explicitly focused on the cognitive processes that respondents use to answer survey questions, including covert processes that are normally hidden, as well as overt, observable ones. Comments were also solicited on the survey to assure that only modest amounts of time are needed to complete it, adequate content representation, and ease of completion.

used to produce scan-readable surveys and an Internet-based option for responding to the survey. The final survey was reviewed and approved by PERF's Institutional Review Board (IRB). The survey instrument is included in Appendix B.

Survey Distribution and Follow-Up Plan

To achieve a good response rate, PERF used a proven survey distribution plan that consisted of (1) two waves of surveys,[35] (2) two waves of reminder letters, (3) faxed survey reminders, and finally (4) reminder phone calls. Following the two survey mailings, as well as the subsequent reminder letters (both mailed and faxed), the remaining non-respondents were contacted by phone. They were reminded of the purpose and importance of the survey and informed that we hoped to receive their survey submissions due to the important nature of the survey. They were sent another copy of the survey if they needed one, and asked to return the survey within 10 days. PERF staff made subsequent phone calls until each survey was received or until the chief executive of a non-responding department conveyed a clear refusal to cooperate. In an effort to ensure the highest quality data, all surveys were reviewed upon receipt for any missing or unclear information. Trained PERF research assistants then called each respondent—specifically the individuals who were responsible for completing the survey—to clarify these data points and receive any missing data. These phone calls occurred soon after the surveys were received by PERF in order to ensure that required information and the survey were still fresh in the respondents' memories.

Data cleaning began upon receipt of each survey, involving a thorough item-by-item review to make sure that all items had been completed and were within reasonable parameters. However, the data was also subjected to rigorous automated data cleaning procedures in SPSS.

Survey Response Rate

Of the 991 agencies that were sent the survey, 782 submitted completed surveys resulting in about an 80 percent response rate. Of the 782 surveys that were received, 475 (60.7 percent) were sent via regular mail, 242 (30.9 percent) via the Internet, 62 (7.9 percent) by facsimile, and three by email (0.4 percent).

35 Each survey was sent out with a self-addressed, postage paid envelope (PPE). Instead of affixing a stamp, the envelope is marked with an account number. If the envelope is returned, the postage is drawn out of a previously created account. This serves two purposes. First, by creating such an account for large mailings, the U.S. Post Office offers a lower postage rate. Second, the PERF account is only charged for envelopes that are returned. The PPE was included to increase the response rate, as past experience has shown that respondents are more likely to respond to a survey request when a PPE is included.

About the Police Executive Research Forum

The Police Executive Research Forum (PERF) is a professional organization of progressive chief executives of city, county and state law enforcement agencies who collectively serve more than 50 percent of the U.S. population. In addition, PERF has established formal relationships with international police executives and law enforcement organizations from around the globe. Membership includes police chiefs, superintendents, sheriffs, state police directors, university police chiefs, public safety directors, and other law enforcement professionals. Established in 1976 as a nonprofit organization, PERF is unique in its commitment to the application of research in policing and the importance of higher education for police executives. Besides a commitment to police innovation and professionalism, PERF members must hold a four-year college degree.

PERF continues to conduct some of the most innovative police and criminal justice research and provides a wide variety of management and technical assistance programs to police agencies throughout the world. PERF's groundbreaking work on community and problem-oriented policing, racial profiling, use of force, less-lethal weapons, and crime reduction strategies has earned it a prominent position in the police community. PERF continues to work toward increased professionalism and excellence in the field through its publications and training programs. PERF sponsors and conducts the Senior Management Institute for Police (SMIP). This program provides comprehensive professional management and executive development training to police chiefs and law enforcement executives. Convened annually in Boston, SMIP instructors include professors from leading universities, with the core faculty from Harvard University's Kennedy School of Government.

PERF's success is built on the active involvement of its members. The organization also has types of membership that allow it to benefit from the diverse views of criminal justice researchers, law enforcement professionals of all ranks, and others committed to advancing policing services to all communities. PERF is committed to the application of research in policing and to promoting innovation that will enhance the quality of life in our communities. PERF's objective is to improve the delivery of police services and the effectiveness of crime control through the exercise of strong national leadership, the public debate of criminal justice issues, the development of a body of research about policing, and the provision of vital management services to all police agencies.

PERF has developed and published some of the leading literature in the law enforcement field. Recently, PERF's work on the increase in violent crime during the past two years has received national attention. A series of reports in the "Critical Issues in Policing" series—*A Gathering Storm—Violent Crime in America; 24 Months of Alarming Trends;* and *Violent Crime in America: A Tale of Two Cities*—provides in-depth analysis of the extent and nature of violent crime and

countermeasures that have been undertaken by police. PERF also explored police management issues in *"Good to Great" Policing: Application of Business Management Principles in the Public Sector*. And PERF produced a landmark study of the controversial immigration issue in *Police Chiefs and Sheriffs Speak Out on Local Immigration Enforcement*. PERF also released two books—entitled *Exploring the Challenges of Police Use of Force* and *Police Management of Mass Demonstrations: Identifying Issues and Successful Approaches*—that serve as practical guides to help police leaders make more informed decisions. In addition, PERF has released a series of white papers on terrorism in the local law enforcement context, *Protecting Your Community from Terrorism: Strategies for Local Law Enforcement,* which examined such issues as local-federal partnerships, working with diverse communities, bioterrorism, and intelligence sharing. Other recent publications include *Managing a Multijurisdictional Case: Identifying Lessons Learned from the Sniper Investigation* (2004) and *Community Policing: The Past, Present and Future* (2004). Other PERF titles include the only authoritative work on racial profiling, *Racial Profiling: A Principled Response* (2001); *Recognizing Value in Policing* (2002); *The Police Response to Mental Illness* (2002); *Citizen Review Resource Manual* (1995); *Managing Innovation in Policing* (1995); *Crime Analysis Through Computer Mapping* (1995); *And Justice For All: Understanding and Controlling Police Use of Deadly Force* (1995); *Why Police Organizations Change: A Study of Community-Oriented Policing* (1996); and *Police Antidrug Tactics: New Approaches and Applications* (1996). PERF publications are used for training and promotion exams and to inform police professionals about innovative approaches to community problems. The hallmark of the program is translating the latest research and thinking about a topic into police practices that can be tailored to the unique needs of a jurisdiction.

To learn more about PERF, visit www.policeforum.org.

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The Bureau of Justice Assistance (BJA), Office of Justice Programs, U.S. Department of Justice, supports law enforcement, courts, corrections, treatment, victim services, technology, and prevention initiatives that strengthen the nation's criminal justice system. BJA provides leadership, services, and funding to America's communities by emphasizing local control; building relationships in the field; developing collaborations and partnerships; promoting capacity building through planning; streamlining the administration of grants; increasing training and technical assistance; creating accountability of projects; encouraging innovation; and ultimately communicating the value of justice efforts to decision makers at every level.

To learn more about BJA, visit www.ojp.usdoj.gov/BJA.

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