

## Ballistic-resistant Body Armor: Problems and Coping Strategies

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### ABSTRACT

*The purpose of this study was to investigate 1) problems with body armor and the consequences of these problems from real user's perspectives, and 2) wearers' coping strategies with body armor problems. Thirteen respondents participated in an in-depth interview study. Participants discussed body armor problems (e.g., hotness, not fitting, heaviness, long-time of wear, partial protection, and not bulletproof /no pointed-type weapon protection) and consequences of the problems (uncomfortable, mobility issues, pain, fatigue, and stress). Participants used both problem and emotion-focused coping strategies to deal with body armor problems: they changed things they could, looked for improvement, and psychologically accepted all the body armor problems.*

*Keywords: body armor problems, coping strategies*

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### Introduction

Body armor refers to vests designed to provide ballistic protection to the vital organs in the torso (National Institute of Justice, 2014). It has been accepted as personal equipment for military, police, and security-related personnel (Horsfall, 2012). Body armor is one of the most important pieces of safety equipment for officers (National Institute of Justice, 2014). Since modern police body armor was introduced into practice in the 1970s, more than 3,100 officer's lives have been saved from assaults with and without weapons or even in car accidents because they wore body armor (National Institute of Justice, 2014). Body armor more than triples the likelihood that a law enforcement officer will survive a shooting to the torso (LaTourrette, 2010).

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However, body armor still has a lot of problems. For example, it is non-fitting, heavy, non-breathable, and only protects vital areas (Barker, Black, & Cloud, 2010; Larsen et al., 2012; Tong & Beirne, 2013). Consequently, body armor has caused both physical (e.g., pain) and negative psychological consequences (e.g., fear of injuries of unprotected body parts) (Knapik, Reynolds, & Harman, 2004; Tong & Beirne, 2013). While body armor is mandatory to wear for uniformed officers and soldiers in their daily duties, no studies have ever investigated how body armor users coped with body armor problems to decrease negative consequences.

In addition, despite interest in body armor, research on this topic has mostly been

conducted with hypothetical consumers rather than real users. For example, studies collected data from volunteers who imitated military activities and discovered body armor problems (e.g., Grenier et al., 2012; Larsen et al., 2012; Knapik et al., 2004). This approach might have some limitations because volunteers were not real users and the activities could not follow strict military standards. This resulted in some studies concluded unexpected results. For example, one study proposed that one problem with body armor was heaviness and therefore soldiers who carry a heavy weight for a longer time would be more tired. The results indicated no difference in fatigue between a 2-hour task and a 21-hour task when volunteers carried the same weight (Grenier et al., 2012). The reason might be because the volunteers could not have been forced to constantly carry a heavy weight for 21 hours and rest and sleep recovered their energy (Grenier et al., 2012). Without real body armor users, it is difficult to make valid and reliable generalizations (Harris, Eccles, Freeman, & Ward, 2017). Therefore, research studies should be conducted on real users, because the real users have more experience with the product and can give comprehensive feedback (Perry et al., 2017). In the current study, body armor users from the military, police, and security-related fields were recruited. This approach should help to understand real users' concerns with body armor problems.

Therefore, the purpose of this study was from to investigate body armor problems and consequences from real user's perspectives and investigate the coping strategies they used to deal with the body armor problems. There were two specific questions: 1) what are the body armor problems and are the negative consequences of these problems? And 2) how did users cope with the body armor problems to reduce negative consequences?

The results of this study will fill a literature gap about how wearers cope with body armor problems to decrease negative consequences. This knowledge may offer insights to better understand body armor

users' mental and physical well-being. In addition, the problems of body armor identified in the current study may help body armor companies to develop better body armor to better fit the needs of military, police, and security personnel.

## Literature Review

### Body Armor Problems and Negative Consequences

Ballistic-resistant body armor includes two types: soft body armor that protects against handgun bullets and hard armor that protects against rifle bullets (National Institute of Justice, 2014). Soft body armor can be worn over a uniform or under a uniform, which is called concealable armor (National Institute of Justice, 2014). Based on levels of ballistic performance, soft body armor includes Levels IIA, II and IIIA and hard body armor includes Levels III and IV (National Institute of Justice, 2014). Body armor usually has a carrier to hold two armor panels: one protects the front of the torso, and the other protects the rear (National Institute of Justice, 2014).

Body armor is one of the most important pieces of safety equipment used by soldiers and law enforcement officers for protection against possible ballistic injury (Loverro, Brown, Coyne, & Schiffman, 2015; National Institute of Justice, 2014). Body armor advantages are obvious: they decrease the chance of injury for the protected areas (e.g., such as the abdomen and chest) and reduce the severity of injuries to the protected areas (Peleg, Rivkind, Aharonson-Daniel, & Group, 2006). Data indicates that law enforcement officers who wear body armor have a significantly lower death rate than officers who do not wear body armor (James, 2016). For example, with a gunshot wound to the torso, law officers who do not wear body armor have a 3.4 times higher risk of dying than officers who wear body armor (LaTourrette, 2010).

Although body armor protects against possible threats, the protection comes at a biomechanical cost (Spevak & Buckenmaier, 2011). Body armor problems

cause many negative consequences (Knapik et al., 2004; Larsen et al., 2012). First, previous studies have well documented how heavy body armor leads to musculoskeletal issues, such as back, neck, upper extremity, knee, low back, and rucksack palsy pain (Knapik et al., 2004). Heavy body armor also impairs mobility and task performance (Larsen et al., 2012). In addition, an uneven weight distribution influences body balance and leg muscle function (Park et al., 2014).

Second, core temperature raised by using body armor also possibly influences task performance (Larsen et al., 2012). Protective clothing restricting heat loss is common in military and law enforcement endeavors (DeGroot, Gallimore, Thompson, & Kenefick, 2013). When wearing body armor to perform physical activities, previous studies have shown an increased heart rate, oxygen consumption, and heat production (Larsen et al., 2012). In a hotter environment or over a longer working period, a wearer's performance would further decline (DeGroot et al., 2013; Larsen et al., 2012). In addition, wearing protective clothing not only elevates body temperature but also decreases cardiovascular strain performance and induces heat-related illnesses (DeGroot et al., 2013).

Third, because most body armors are not custom made, but a sized item with a limited size range, maximal comfort and maneuverability are not guaranteed (Choi et al., 2016). Previous studies have documented that fit issues further lead to discomfort and mobility issues (Barker et al., 2010; Park, Park, Lin, & Boorady, 2014). In addition, ill-fitting protective wear also negatively influences work efficiency and the safety of the wearer (Park et al., 2014). According to Choi et al.'s (2016) study, fifteen male soldiers participated in a marksmanship performance task using a weapon simulator, and the results indicated speed was degraded with ill-fitting body armor sizes. Ill-fitting body armor is especially a problem for female law enforcement officers (James, 2016).

Fourth, partial protection is a problem. Modern body armor has decreased

fatal-penetrating injuries to the chest but offers no protection to the limbs, neck, and face, which remain exposed to gunshot and explosive fragments (Tong & Beirne, 2013). Because of mobility concerns, soldier's faces and necks in combat settings are commonly unprotected (Tong & Beirne, 2013). Therefore, for combat personnel, head, face, and neck injuries are the second most common injuries, and one of the most important reasons is lack of adequate protection for the face and neck (Tong & Beirne, 2013). Similarly, without protection of the limbs, loss of limb has occurred for a larger percentage of surviving soldiers (Goldberg, 2014). In addition, a law enforcement officer or soldier may be killed because he/she is shot in the torso where there is a gap in the body armor, such a bullet could enter through the side panels of the vest, the armhole, or the shoulder area (James, 2016). According to a report from a congressional research service, from 2005 to 2014, 67% (338) of the 505 non-federal law enforcement officers were killed when they were wearing body armor (James, 2016). Most law enforcement officers who were killed with a firearm while wearing body armor were shot in the head and neck, and some of them were shot in a part of the torso that was not protected by the body armor (James, 2016).

Because the problems of body armor cause a lot of negative consequences (e.g., discomfort, reducing mobility, increasing weight, and increasing heat stress), some law enforcement officers are not willing to wear armor vests (James, 2016). Unfortunately, body armor can only protect wearers when they wear it (James, 2016). A lot of studies have suggested the development of better body armor that could offer a higher level of protection while also being lighter and more comfortable, having more protective coverage, and being a better fit for female officers (Barker et al., 2010; James, 2016; Tong & Beirne, 2013). However, before such an ideal body armor becomes a reality and is available for users, military, law enforcement, and security personnel, they must wear their current body armor with its problems and suffer from the negative

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consequences. Therefore, studying how to deal with the problems of body armor is worth our investigation.

### **Coping Strategies: theory and applications**

Coping as a process theory refers to coping changes over time and in accordance with the situational context in which it occurs (Lazarus, 1993). From this perspective, coping is a process of recalling a potential response to a perceived threat/problem to oneself (Lazarus & Folkman, 1984). Coping strategies include both psychological and behavioral efforts that people use to reduce stress created by problems (Snyder, 1999).

The theory of coping as a process emphasizes that there are two general types of coping strategies people used to cope with possible stressful situations. One is a problem-focused coping, which is aimed at solving a problem and altering the situation (Carver, Scheier, & Weintraub, 1989). The second is an emotion-focused coping, which is aimed at reducing the emotional distress that is associated with the situation (Carver et al., 1989). Usually, most problems elicit both types of coping to deal with them (Carver et al., 1989; Folkman & Lazarus, 1980). Problem-focused coping is predominantly used when people feel a situation can be constructively dealt with, while emotion-focused coping is mostly used when people feel the situation must be endured (Folkman & Lazarus, 1980).

Many studies have examined veterans or law enforcement officers coping strategies. However, these studies have focused on dealing with negative consequences, such as mental stress or physical pain, caused by war or by their jobs (e.g., Anshel, 2000; Armstrong, Best, & Domenici, 2009; Robbins, Vreeman, Sothmann, Wilson, & Oldridge, 2009). In these studies, participants are wounded soldiers or police officers who had mental health issues such as depression, anxiety, interpersonal conflicts, post-traumatic stress disorder, and physical health issues such as chronic pain (Anshel, 2000; Knapik et al., 2004; Spevak & Buckenmaier, 2011). Both emotion and problem-focused coping

strategies have been used as effective treatments to reduce the negative consequences (Spevak & Buckenmaier, 2011). In one study, to reduce emotional distress associated with war memories and help change the way veterans cope with unwanted memories (e.g., avoid triggers of these memories), veterans practice activities to create distance between themselves and the memories, and therefore allow them to look at their memories normally rather than be emotionally triggered by them (Armstrong et al., 2009). In another study, soldiers were encouraged to emotionally grieve their loss of functions as well as disfigurement; at the same time, encouragement of self-acceptance was utilized to decrease negative beliefs about themselves (Spevak & Buckenmaier, 2011).

Body armor protects against possible threats; at the same time, it has problems, and these problems bring negative consequences to the wearer's psychological and physical health (Larsen et al., 2012). For example, fear of injuries from unprotected body parts causes mental stress, and heavy body armor causes physical pain (Knapik et al., 2004; Larsen et al., 2012; Spevak & Buckenmaier, 2011; Tong & Beirne, 2013). However, so far, no studies have examined how law enforcement officers, soldiers, and security personnel coped with the body armor problems to decrease these negative consequences.

Unlike the previous studies (Anshel, 2000; Armstrong et al., 2009; Robbins et al., 2009), the current study does not examine coping strategies associated with negative consequences of body armor, such as mental health issues and physical pain. The reasons are the following. First, coping strategies associated with mental health issues and physical pain have been well documented in previous literature (e.g., Anshel, 2000; Armstrong et al., 2009; Robbins et al., 2009), while no studies have examined coping strategies associated with the problems of body armor. Secondly, it is difficult to separate mental health issues and physical pain that was caused by body armor problems and that were caused from the participant's

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job duties (e.g., pain caused by heavy body armor or pain caused by combat fighting). Thirdly, dealing with the problems was more direct than dealing with consequences caused by those problems. Investigating coping strategies for body armor problems is an active way to try to reduce the negative consequences caused by the problems.

## Method

### Procedure

A qualitative research method, in-depth interview, was used to collect data (Hedrick, Bickman, & Rog, 1993). An Institutional Review Board (IRB) approved this study. Participants were recruited through flyers both online and offline. The flyers were sent to people who possibly own body armor: law enforcement offices (e.g.,

police departments and court offices), gun stores, body armor websites, shooting ranges, and military offices. All participants must have owned body armor.

A total of 13 respondents participated in the in-depth interview study (Table 1). Except for one female participant, all participants were males ( $n = 12$ ). Three participants did not complete the demographic information. Of the rest of the 10 participants, most of them were white ( $n = 8$ ). Most of them have a bachelor's degree ( $n = 5$ ) or a high school degree ( $n = 3$ ). A few of them have a master's ( $n = 1$ ) or a doctoral degree ( $n = 1$ ). Their ages ranged from 20 to 62. With the participant's consent, interviews were audiotaped and conducted in person, on Skype, or by phone. Interviews ranged from 37 to 62 minutes in length.

**Table 1. Participants' profiles**

	Age	Gender	Education	Ethnic	Job background
P1	38	Male	Masters	White	Military
P2	30	Female	Bachelors	White	Law enforcement
P3	43	Male	Bachelors	White	Law enforcement
P4	59	Male	Bachelors	Hispanic/Latino	Law enforcement
P5	---	Male	----	----	Military/Security
P6	23	Male	Bachelor	White	Military/Law enforcement/Security
P7	20	Male	High School	White	Security
P8	20	Male	High School	White	Law enforcement
P9	52	Male	Doctoral	American Indian	Military/Law enforcement
P10	62	Male	Bachelor	White	Security
P11	----	Male	----	----	Law enforcement
P12	----	Male	----	----	Law enforcement
P13	55	Male	High School	White	Law enforcement

Each participant was assigned a pseudonym to ensure confidentiality, ranging from participant 1 to 13 (P1-P13). Two trained coders worked on the transcripts. The inter-rater reliability was .84, which was considered good reliability (Stokes, Deitz, &

Grove, 1990). A phenomenological interpretation method was used to analyze the data (Smith & Osborn, 2003). Themes and analytical relationships among themes were identified (Smith & Osborn, 2003).

## Results and discussions

The reasons to have body armor were all related to job duties ( $n = 13$ ), such as law enforcement ( $n = 9$ ), military ( $n = 4$ ), and security ( $n = 3$ ). Their job roles involved various functions: intelligence support, bomb technician, property crime, person's crimes, gang unit, law enforcement supervisor, detective, narcotics, special weapon and tactics (SWAT) team, security guard, security director, etc. None of them were ordinary civilians who owned body armor. Most participants had Level IIA, Level II, and Level IIIA body armor, which are soft body armor designed to protect against handguns. Some participants had Level III and Level IV body armor, which are hard plated body armor and are designed to protect against rifles. Participants who used Level IV body armor either came from the military, the SWAT team, or special tactics (e.g., bomb technician).

### Theme 1. Body armor' problems and consequences

Participants discussed the most important function of body armor, including protection ( $n = 11$ ) and comfort ( $n = 2$ ). Body armor not only offers physical protection for wearers ( $n = 12$ ), but also offers a psychological safe feeling for them ( $n = 7$ ). Participants also described problems of body armor, including hotness ( $n = 13$ ), non-fitting ( $n = 10$ ), heaviness ( $n = 9$ ), long time to wear ( $n = 7$ ), partial protection ( $n = 7$ ), and not bulletproof/ no pointed-type weapon protection ( $n = 3$ ). Consequently, these problems brought negative experiences, such as uncomfortableness ( $n = 13$ ), impacted mobility ( $n = 10$ ), pain ( $n = 7$ ), fatigue ( $n = 4$ ), and stress ( $n = 4$ ).

### The most important function of body armor

**Protection** ( $n = 11$ ). Almost all participants believed that the most important function of body armor was protection, so they can fulfill their duties, protect others, and survive to be with their families. They were not only law enforcement officers, they were also mothers and fathers. They wanted

to "come home safely" (P4). A mother wore body armor even though she got heat rush because she wants to see her son "every night" (P2). A father upgraded his body armor coverage because he has "got three kids" (P3).

Physical protection was described from almost all participants ( $n = 12$ ) as a positive experience of body armor. Although body armor could not totally prevent injuries, it did minimize the injuries to participants or their co-workers. For example, a police officer was shot in the body armor, but he was still fully functional and took control of the suspect. A soldier's ceramic plate body armor was designed to stop high-velocity rifle shooting rather than a pointed-type weapon; the body armor successfully stopped a knife from penetrating through to the chest. And a security guard was knocked down and hit by a bat, while fortunately, his body armor protected him from serious injuries.

Body armor offers not only physical protection, but a psychological safe feeling for wearers. More than half of the participants ( $n = 7$ ) mentioned that body armor boosted their safety confidence. Without body armor, police officers did not feel "nearly as comfortable to come in contact with people" (P2), and soldiers felt "so weird, like I was naked" (P5). The body armor was like a comfort zone. "It helped me through my daily basis knowing that if something happened then it was there to protect me" (P7).

**Comfort** ( $n = 2$ ). However, two participants believed comfort rather than protection was the most important function of body armor. "You can walk around with a steel plate, and it would give you more protection" (P13). While if it was not comfortable, "people are not going to wear it" (P12).

### Body Armor Problems

**Hotness** ( $n = 13$ ). All participants complained about hotness issues. "It is really hot during the summer...it's just so sweaty and hot underneath" (P2). Non-breathable materials contributed to hotness. "There wasn't a lot of breathability in the army plates. The fabric doesn't breathe very well"

(P6). To avoid heat and sweat, they preferred to work on over-night shifts, frequently switched underclothing, and wore wick away sweat undershirts. However, “you don’t soak in your sweat, but it starts to get real slick and slide on your chest” (P12). In addition, odor was also a problem associated with being hot and sweaty.

**Non-fitting** ( $n = 10$ ). Body armor is either one-size-fits-all or only several options: small, medium, large, and extra-large. Therefore, body armor was either too big or too small. “It may not fit just right underneath your armpits” (P4). Participants had to constantly adjust Velcro straps and a waist strap to fit better. For the female, fit in the bust area was especially important.

**Heaviness** ( $n = 9$ ). The weight of body armor depends on the body armor’s level. Soft body armor weight was not an issue. For example, a Level IIIA body armor was about 2-3 pounds. However, a level IV plate “was about 10 pounds, and two plates were about 20 pounds” (P1). With other gear, duty belts, and tools, some law enforcement officers had to carry about “35-40 extra pounds” (P3). Soldiers carried even more weight: from “77 pounds” (P5) to “110 pounds” (P5).

**Long time of wear** ( $n = 7$ ). Long time of wear for body armor was also an issue. Participants had to deal with their unfitted, heavy, and hot body armor for “eight hours” (P10), “12 hours a day” (P2), or “15-16 hours”, depending on their shift and their missions.

**Partial protection** ( $n = 7$ ). Participants were worried about their unprotected body parts. “I always ask the question, what if they shot me in the face, or the leg, or something else” (P1). Unprotected body parts did get shot often. As a veteran described, “the rounds are always hitting people’s face, neck, and limbs... most often limbs” (P5). However, nobody wanted to lose body parts. “I can’t imagine a life without arms, or legs, or eyesight” (P1).

**Not bulletproof/no pointed-type weapon protection** ( $n = 3$ ). Body armor was not bulletproof. Soft body armors, such as Levels IIA, II and IIIA, cannot stop rifle

bullets. Even though body armor stops a bullet, “you’re still going to get significantly injured. Break some ribs, hurt your thorax, internal bruising or internal bleeding” (P3). Furthermore, another downside of body armor was that it is “generally ineffective against knives, or other pointed-type weapons.”

### Consequences of the Problems.

**Uncomfortableness** ( $n = 13$ ). Uncomfortableness was caused by body armor problems: non-fitting, heaviness, hotness, not free to move, and longtime of wear. Body armor was bulky, heavy, stiff, and hot, “it’s pretty much a cookie cutter vest” (P13). Uncomfortableness was also associated with wearer’s postures (e.g., standing up is more comfortable than sitting down behind the wheel of a vehicle), using male body armor for females, and whether people were used to it. “I’ve been wearing body armor now for thirty years ... I’ve gotten used to it” (P9).

**Impact mobility** ( $n = 10$ ). Mobility was impacted by unfitted body armor. An unfitted rectangular plate extends out to the shoulders and causes problems in moving the arms. However, a reduced front panel (a triangle cut or a shooter cut) allows arms to move or to shoot. Heaviness also lead to mobility problems. With 70-110 pounds of gear, “people just not being able to fully operate their weapon system... because it’s so bulky, they can’t just move their arms and manipulate their weapon to their shoulder quick enough” (P5).

**Pain** ( $n = 7$ ). Pain was caused by wearing heavy, hot, and non-fitting body armor for a long period. The weight overtime caused hip, shoulder, neck, and back pain. Hotness also caused heat rash over the torso in the summer. If it is unfitted, “it’ll end up hurting. The body is fighting the plates instead of working with it” (P6).

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**Fatigue** ( $n = 4$ ). Heavy weight, long time of wear, and hot conditions all contributed to fatigue. Unfitted body armor also caused fatigue. When females wear unfitted male body armor, “it’s just squeezing you down all day long is certainly going to contribute to your fatigue” (P3).

**Stress** ( $n = 4$ ). Participants suffered a lot of stress. “The fact that everyone has a gun...it’s really easy to buy a gun” (P6). Mass media continues showing “somebody got stabbed, somebody got shot” (P5). “It is stressful” (P6). In addition, they had to deal with extra stress because of their jobs. For example, one subject could not sleep in Afghanistan because the troop would “get attacked almost every single night” (P1).

## Theme 2. Coping Strategies

Participants described how they dealt with body armor problems. Both problem and emotional-focused coping strategies were used. Depending on perceived threat levels, participants changed protection levels of body armor. Some participants increased protection levels ( $n = 9$ ), while others decreased protection levels ( $n = 2$ ) for more comfort. They were also looking for improvement of their body armor, either from design ( $n = 6$ ), engineering, or science perspectives ( $n = 7$ ). In addition, emotional-focused coping strategies were also utilized. Participants psychologically accepted that body armor is only partial protection, it is not bullet proof ( $n = 13$ ), and all the other problems ( $n = 9$ ). Although body armor has so many problems to cause negative consequences, all the participants ( $n = 13$ ) overall were still satisfied with their body armor, because “it does what it needs to do. Therefore, I’m satisfied” (P9).

### Problem-focused coping: Change things

**Increase protection levels** ( $n = 9$ ). “Because we know there are extra threats” (P3), some of the participants increased their level of protection, for example, from a level III to a level IIIA. Others bought an additional plate with a stab proof function. Other participants from security companies bought or borrowed body armor for

themselves, because their companies did not offer body armor to unarmed security guards. Although risks were relatively low, these unarmed security guards still increased their protection levels in case something may happen.

### Decreased protection levels

( $n = 2$ ). However, a few participants decreased protection levels. In a security company, “our threat level was like a zero” (P5). Therefore, a mandated policy of wearing body armor was changed to be optional. Similarly, a military officer analyzed his situation and concluded that the chance to be shot was very low. Therefore, he preferred more comfortable body armor.

### Problem-focused coping: improve body armor

**Design** ( $n = 6$ ). Most participants ( $n = 7$ ) did not care about design and did not think design can contribute body armor. Some participants ( $n = 6$ ) believed design could improve body armor. First, design can solve some protection issues, such as a better side panel or eliminate the gap between front and back panels. Second, design can solve fit issues. Some law enforcement organizations used a customization method to make body armor. Personal measurements were taken, and different positions (e.g., shooting positions) were considered. Third, an ergonomic design could reduce pain and uncomfortable feelings. From an ergonomic perspective, an external body armor carrier was a significant improvement. The body armor and tools weight was carried on body skeleton rather than the shoulders (as cancelable body armor does) or the waist (as a heavy-duty belt does). Therefore, an external carrier design helped to significantly decrease back, shoulder, neck, and hip pain. In addition, wearers could take off external carriers and take a break if the body armor is too hot and uncomfortable. Fourth, the carrier’s design also increased ease of use and efficiency. For example, a left-handed shooter would prefer magazines on the right side because the left hand was always busy holding the rifle and could reload the rifle from the right side.

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**Engineering or science improvement** ( $n = 7$ ). Most participants believed only scientific improvement of body armor could really solve the body armor problems. They hoped to have body armor that "is thinner, lighter, and cooler, and gives the same kind of protection of what we are currently using" (P4). "I've always wondered, if we can send a man mission to Mars and the moon...and materials that withstand space, why can't we make like really thin, super lightweight body armor, and then the type that can curve and be fitted, but yet at an affordable cost?" (P1). In addition, unlike the above carriers' design, they hoped to have a high-tech carrier that can save the wearer's life. For example, "if bullets penetrate body armor, it takes a clotting agent into the body" (P9). The carrier has "biometric sensors built into it that monitor pulse rate, and blood pressure, and respiration" (P9). The carrier could also "build life-saving technology into it, such as if somebody's heart had an irregular heartbeat you build in an automatic defibrillator that jumpstarts them, so their heartbeat gets put back to normal" (P9).

#### **Emotion-focused coping: Psychologically accepted**

**Accepted partial protection** ( $n = 13$ ). All participants accepted partial protection. Nobody could have a lightweight ballistic cover for the entire body. They had to sacrifice limb protection for mobility. "This is just something that every officer accepts" (P2). Second, partial protection was better than no protection. "It's better than just having your shirt trying to stop a bullet" (P3). Third, compared with rangers, infantry, or the marines, they knew that they had much lower risks. Fourth, even after getting shot, they knew they would survive with protection of the vital areas.

**Accepted not bulletproof** ( $n = 6$ ). Nearly half of the participants accepted that body armor is not bulletproof. They knew their body armor was not bulletproof and they may get serious injuries. But at least the body armor would protect them "from immediate death" (P1).

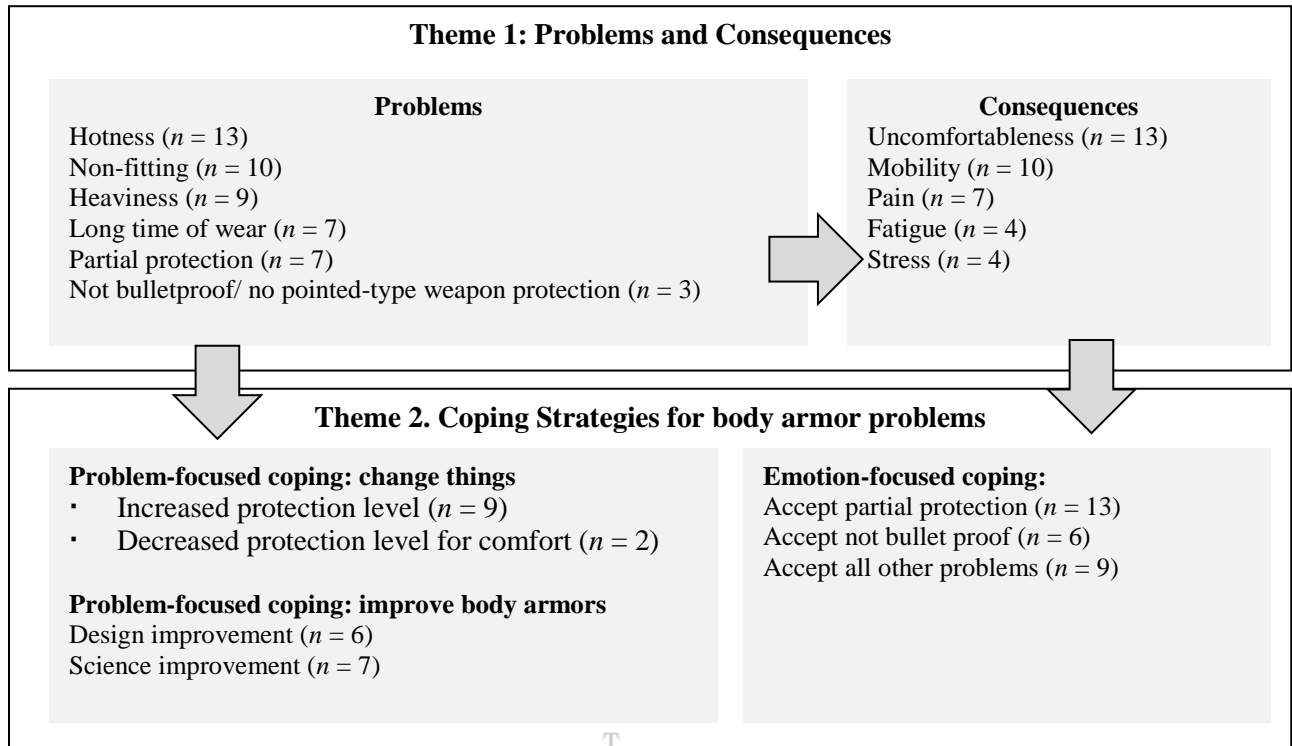
**Accepted body armor's other problems** ( $n = 9$ ). Eventually, participants just accepted that "body armor is not comfortable" (P9). "You just cannot have proper ballistic protection and comfort at the same time" (P3). They made their decisions to sacrifice comfort for protection, and they believed "it's worth it" (P2). In addition, most participants successfully convinced themselves to positively accept their body armor, after comparison with previous body armor and other worse body armor (e.g., soldiers' heavy and low-quality armor). Although their body armor was not comfortable, they were much better than previous older ones and military body armor. "I don't believe a military service person can deviate much from what is provided to them, they're just given the protection, and that is what they have to deal with" (P3).

#### **Discussion and Conclusion**

The purpose of this study was to investigate 1) problems and negative consequences of body armor and 2) coping strategies for the problems from real users' perspectives. Two themes and inter-relationships among themes were identified. Theme 1 identified problems and negative consequences of body armor (Figure 1). Most participants ( $n = 11$ ) believed the most important function of body armor was protection. Consistent with previous studies (James, 2016; Loverro et al., 2015; Peleg et al., 2006), body armor physically successfully protected wearers from serious injuries ( $n = 12$ ). Not only physically, body armor also gave wearer's a psychological safe feeling: it boosted their safety confidence ( $n = 7$ ).

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**Figure 1. Body armor problems and consequences, and coping strategies**



Note:  $n$  means the number of participants. The total participants were  $n = 13$ .

Consistent with previous studies (Spevak & Buckenmaier, 2011, Tong & Beirne, 2013), body armor also had a lot of problems: hotness ( $n = 13$ ), non-fitting ( $n = 10$ ), heaviness ( $n = 9$ ), longtime of wear ( $n = 7$ ), partial protection ( $n = 7$ ) and not bulletproof/no point-weapon protection ( $n = 3$ ). Because of these problems, participants suffered a lot of biomechanical consequences (DeGroot et al., 2013; Knapik et al., 2004; Spevak & Buckenmaier, 2011): uncomfortableness ( $n = 13$ ), mobility issues ( $n = 10$ ), pain ( $n = 7$ ), fatigue ( $n = 4$ ), and stress ( $n = 4$ ). Different from a previous study's conclusion that there was no difference between fatigue level of a 2-hour task and a 21-hour task (Grenier et al., 2012), the current study indicated a long time of wear body armor decreased comfort and contributed pain and fatigue. The contradictory results might be because Grenier et al. (2012) recruited volunteers to imitate military activities and the activities could not follow strict military standards.

Therefore, the results of this study support previous research conclusions that studies should be conducted on real users to get accurate data (Perry et al., 2017).

Theme 2 identified coping strategies that participants developed to deal with body armor problems. The results indicated that participants used both problem and emotional-focused coping strategies to deal with body armor problems, this supports previously conducted studies' conclusion that most problems elicit both types of coping (Carver et al., 1989; Folkman & Lazarus, 1980).

Consistent with previous studies (Carver et al., 1989; Folkman & Lazarus, 1980), participants used problem-focused coping strategies to alter their situation when they felt the situation could be changed. To solve the problem that body armor is not bulletproof and does not have pointed-type weapon protection, some participants increased protection levels ( $n = 9$ ) by using higher levels of body armor, buying an extra

plate with a stab proof function, and buying or borrowing body armor for themselves. To solve body armor comfort problem caused by non-fitting, heaviness, hotness, not free to move, and longtime of wear, a few participants simply decreased their protection levels for comfort ( $n = 2$ ). In addition, almost all participants have tried to look for improvement of body armor either from design ( $n = 6$ ) or by engineering/science perspectives ( $n = 7$ ). For example, functional design could improve body armor fit; ergonomic design was a successful solution for pain and uncomfortableness; carrier design can increase ease of use, and engineering or science improvements may significantly change current body armor.

When individuals can do little to change things, problem-focused coping might cause frustration and non-productivity (Baum, Fleming, & Singer, 1983). Therefore, when individuals realized they must endure a situation or a problem, they use emotion-focused coping (Carver et al., 1989; Folkman & Lazarus, 1980). After participants used the above problem-focused coping strategies to change problems of the body armor (e.g., increase protection level, improve body armor from design or engineer/science perspectives), all participants ( $n = 13$ ) used emotional-focused strategies to accept body armor problems. All of them accepted that body armor is only partial protection ( $n = 13$ ) and nearly half of them accepted that body armor is not bulletproof. They knew they could have done little to change their situation, because nobody could have lightweight ballistic body armor for the entire body. They convinced themselves that partial protection is better than no protection; and even though they may be shot, at least they can survive. They knew body armor is not bulletproof, but at least body armor can prevent immediate death.

Most of the participants also accepted all of the other problems of body armor ( $n = 9$ ), such as hotness, non-fitting, heaviness, and the necessity to wear it for long hours. Participants understood safety concerns and the important function of body armor (Song & Kim, 2015), and they were

willing to sacrifice comfort for protection. In addition, they also found many reasons to comfort themselves. For example, the current body armor was better than the previous or even military body armor. The results indicated that participants successfully positively reinterpreted body armor: it is worth suffering from the problems (e.g., uncomfortableness, partial protection) to gain the most important functions (e.g., life-saving protection).

Although body armor has many problems and causes many negative consequences, all participants overall were satisfied with their body armor, because body armor offers the protection they need. The result supported the findings of a previous study, that needs were the most important reason to have a product; even though a product may have a lot of problems, participants would continue to have it as long as it satisfied the users' dominant needs (Perry, 2017). The current study further expanded Perry's (2017) conclusion: even if a product has a lot of problems, as long as it can satisfy a user's dominant needs (e.g., protection), participants will find coping strategies to convince themselves to accept the product and continue using it.

### Implications

This study has several implications. Body armor product development teams can use knowledge from the current study to design better body armor. Although coping strategies for veterans have been well studied, no studies have examined how law enforcement officers, soldiers, and security guards cope with body armor problems. The current study fills a research gap by offering insights about coping strategies with body armor. The results of this study would benefit various organizations to better understand law enforcement officers, soldiers, and security guards' physiological well-being and find coping strategies to train new officers or soldiers to face the problems of body armor.

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### Limitations and Future Studies

This study had several limitations. First, only one participant was female. It was impossible to notice whether gender influenced the results. Future studies may balance the gender of the participants. Secondly, the current study examined coping strategies with body armor problems from military, police, and security personnel's perspectives. Because of the limited sample size, it was impossible to investigate whether there were different coping strategies among the three types of participants. Future studies may try to make comparisons of findings among different types of participants. Thirdly, the current study did not distinguish coping strategies for different levels of body armors. Level IV may have more heaviness problems than a Level IIA body armor. Future studies may select a specific level body armor and further investigate coping strategies associated with problems of the body armor.

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