



Psychobiological stress response to a simulated school shooting in police officers



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Summary

Introduction: Police work is one of the most demanding professions with various sources of high occupational stress. Among the most demanding tasks are amok situations, such as school shootings. Hardly anything is known about endocrine and cardiovascular markers in safety professionals during emergency situations in real life and how this relates to stress perception and management. This study will therefore explore police officers' stress responses to a reality-based school shooting simulation assessing neuroendocrine, cardiovascular, and psychological stress markers.

Methods: A convenience sample of 50 police officers (39.5 ± 8.7 yrs, 9 women) participating in a basic or refresher amok training session for the German uniformed and criminal police were recruited. Saliva samples were collected shortly before the simulation task (school shooting), immediately after, 20 and 45 min after finishing the task for the assessment of cortisol and alpha-amylase (sAA), as markers of the hypothalamic–pituitary–adrenal axis and the autonomic nervous system, respectively. Heart rate (variability) was assessed continuously. Officers rated their actual mood right before and 10 min after the simulation. Subjective experience of task stressfulness was assessed minutes after finishing the simulation.

Results: Overall, the simulated school shooting did not result in changes of mood, tiredness, or calmness but higher restlessness was experienced during the basic training, which was also experienced as more controllable. Female officers reported to experience more strain and anxiety. Cortisol showed highest levels at the beginning of the training and steadily decreasing values thereafter. In contrast, sAA increased substantially right after the simulation with officers on the front position showing most pronounced changes. Cardiovascular reactivity was highest in officers acting on the side positions while advancing to find the suspect. Furthermore higher self-efficacy as well as, by trend, controllability and relevance of results correlated with cardiovascular measures.

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Discussion: Autonomic but not endocrine stress markers increased to a simulated school shooting, which were further related to the subjective experience of the simulation. Our results provide a more in-depth picture of stress responses in such situations, which will in the long run raise the possibility to refine training programs, design more effective stress-management strategies for these critical incidents, and improve performance but also coping with work-related stress.

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1. Introduction

Police work is characterized by a multitude of presumably dangerous situations regarding one's own life or the life of others. Among the most demanding tasks are amok situations, such as school shootings (from the Malay word *meng-âmok* – attack and kill in blind rage). The police are responsible to initiate contact with the suspect, arresting him/her, and rescue hostages. The person running amok is often armed, shows very aggressive behavior, i.e. is ready to use violence, and often holds other people hostage. In Germany, about 100 amok situations made the news in the last 20 years, with a trend toward an increase of school shootings (Peter and Bogerts, 2012). As a consequence of these critical incidents and other sources of high occupational stress, higher rates of divorce, depression, posttraumatic stress disorder, suicidality, physical health problems, and an unhealthy life style are found in police officers compared to the general population (Cartier et al., 1997; Stuart, 2008; Gershon et al., 2009; Sonnentag and Jelden, 2009; Clark-Miller and Brady, 2013). It is therefore of great interest to investigate stress perception and management of critical incident scenarios as well as underlying psychobiological mechanisms in this group.

Since it is virtually impossible to study the psychobiological response to an amok situation in real life, our knowledge about the demands a police officer meets in these situations is lacking. One approach toward the study of these demands is to examine officers during a simulated school shooting. Simulations of critical incident scenarios are regularly carried out to prepare officers for this emergency. Considering the characteristics of an amok situation, such as novelty, uncontrollability, personal and others' threat of injury, and death, the biological stress response should comprise activation of the hypothalamic–pituitary–adrenal (HPA) axis, the autonomic nervous system (ANS), and the immune system (e.g., Dickerson and Kemeny, 2004). Some studies have already addressed the biological and psychological demands of highly stressful and dangerous professions including police work, firefighting, emergency care/paramedicine, and military service. These studies suggest increased endocrine, cardiovascular and inflammatory markers in these subjects during emergency situations in real life (Benzer et al., 1991; Pottier et al., 2011), simulated scenarios (Smith et al., 2005; von Heimburg et al., 2006; Perroni et al., 2009; Sal et al., 2009; Groer et al., 2010; Huang et al., 2010; Leblanc et al., 2012; McGraw et al., 2013; Roy et al., 2013) and when comparing levels of biomarkers to that of controls (Ray et al., 2006; Franke et al., 2010; Ramey et al., 2012). While there are several studies dealing with the consequences of police work on endocrine and cardiovascular health parameters (e.g., Violanti et al., 2006), only

few studies examined officers during their shift or under acute work-stress conditions and investigated more than one stress-responsive system. Zefferino et al. (2006) showed higher blood pressure and salivary cortisol, a marker of HPA axis activity, at the beginning of the shifts and compared to levels during the holiday. Another study investigated law enforcement officers during two virtual reality scenarios of different intensity (short chase of a motorcyclist vs. lengthy chase of an armed suspect engaging in gunfire; Groer et al., 2010). Cardiovascular markers as well as salivary cortisol and alpha-amylase (sAA), a surrogate marker of autonomic activity (e.g., Granger et al., 2007; Nater and Rohleder, 2009), were markedly increased in the lengthy scenario while sAA was even increased during the short chase (Groer et al., 2010), confirming the stressfulness of these situations. However, some shortcomings of virtual reality scenarios have to be considered. In particular, the technology for natural or immersive experiences, e.g. haptic systems providing physical feedback, lack credibility. Also, headphones, head-mounted displays, and wires limit full natural movement. Therefore, training scenarios in the natural environment are assumed to better reflect reality, that is, they have higher ecological validity. Of note, a reality-based handgun practice was shown to increase sAA and subjective stress as well as worsening shooting performance compared to cardboard practice (Taverniers and De Boeck, 2014). This study highlighted the effects of a realistic environment on stress-related performance deficits. If a simulated school shooting might serve as a valid work-related task in relation to the "real-life" police work remains an open question. In this scenario, officers work under high time pressure, with the principle task to locate the suspect and to avoid harm and danger from possible hostages and themselves. Of note, the handling of such critical incidents relies on principles that require officers to secure one cardinal direction (here named position "3", "6", "9", and "12"; see Fig. 1) to assure 360° security. Each position encompasses specific tasks and responsibilities what might be related to a different perception of and response to the situation.

The main purpose of this study was therefore to examine police officers' response to a simulated school shooting in a natural environment, considering neuroendocrine, cardiovascular, and psychological components of the stress response. Due to their easy implementation in field settings, salivary cortisol and sAA were examined as markers of HPA axis and ANS reactivity, respectively. Heart rate (HR) and heart rate variability (HRV) were continuously monitored and officers rated the stressfulness of the situation as well as their current mood. It was hypothesized that a simulated school shooting results in elevated neuroendocrine and cardiovascular markers and this should be especially pronounced in those officers reporting the highest perceived

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