



Physical evidence of police officer stress

Physical evidence
of police
officer stress

Gregory S. Anderson, Robin Litzenberger and Darryl Plecas
*University College of the Fraser Valley, Mission,
British Columbia, Canada*

399

Keywords *Police, Stress, Work study, Canada*

Abstract *The purpose of the present study was to identify common stressors and the magnitude of stress reactivity in police officers during the course of general duty police work. Using heart rate as a primary indicator of autonomic nervous system activation, coupled with observed physical activity data collected through 76 full shift ride-alongs, this study differentiates between physical and psycho-social stress. The results, confirming previous research based on self-report data alone, demonstrate that police officers experience both physical and psycho-social stress on the job, anticipating stress as they go about their work, while suffering anticipatory stress at the start of each shift. The results demonstrated that the highest levels of stress occur just prior to and during critical incidents, and that officers do not fully recover from that stress before leaving their shift. Overall, the results illustrate the need to consider stress reactivity and repressors in the assessment of police officer stress while clearly demonstrating the need for debriefing after critical incidents and increased training in stress management and coping strategies.*

Taken as a whole, research on policing and stress suggests that police work is in fact stressful. As Anshel (2000), citing others, reminds us, it is one of the most stressful occupations in the world. We also know that stress, particularly when it becomes chronic, can lead to a multiplicity of problems for the officers as well as for the organization they work for. For example, the literature on police officer stress indicates that stress can lead to a greater likelihood of absenteeism, burnout, job dissatisfaction, early retirement or attrition, a weakened immune system with increased short- and long-term illness, long-term disability, poor work performance, and potentially, premature death (Anshel, 2000; Kirkcaldy *et al.*, 1995; Burke, 1994; Brown and Campbell, 1990; Vena *et al.*, 1986; Violanti *et al.*, 1986; Alkus and Padesky, 1983; Nordlicht, 1979; Modlin, 1978).

While there is ample literature using self-report measures of perceived stress and questionnaire techniques to identify the perceived sources and magnitude of stress in policing, there is a lack of physiological data to support such data (see Anshel, 2000; Anshel *et al.*, 1997; Violanti and Aron, 1995). Further, stress research in policing has typically focussed on the nature and effects of chronic stress (Anshel, 2000; Evans and Coman, 1993) while literature identifying the sources of acute stress and stress reactivity are rare (Anshel *et al.*, 1997; Eden, 1990). For this reason, the purpose of the present study was to identify the acute physical and psycho-social stressors in police work, quantifying the stress reactivity through the use of heart rate monitoring. In this way, the

This study was funded by the Attorney General's Office of British Columbia, through the Police Academy of the Justice Institute of British Columbia, and through a SSHRC Aide to Small Universities research grant.



present study will be able to identify common stressors and the magnitude of stress reactivity police officers should expect to encounter during the course of their general duty police work.

Stress physiology

Police officers are often exposed to acute stressors beyond the realm of normal human experience. At any time during the police officers' shifts, they may be called upon to respond to situations in which there is a threat to their physical well-being, or the physical well-being of a fellow police officer, or the general public. These critical incidents are sudden, and are perceived in a way that the officer's coping mechanisms are overwhelmed and the officer is in distress (Kureczka, 1996; Evans and Coman, 1993). This sudden-onset stress is characterized by a rapid increase in catecholamines (epinephrine, norepinephrine and dopamine), increasing physiological arousal, alertness and enhanced memory consolidation (Arnsten, 1998). After a brief period of time, this initial reaction is followed by an increase in glucocorticoids (primarily cortisol) which shuts down the digestive system, redistributes blood, moving it away from the internal organs to the muscles, and mobilizes the energy reserves. These events are typical of the fight-or-flight response described by Cannon (1932), and are equivalent to the "alarm reaction" in Selye's (1956) stress reactivity model.

Regardless of the source of the stressor, once a situation is perceived as threatening or challenging, the stress reaction is similar. Cannon (1932) described the reaction to a stressor as the "fight-or-flight response". The fight-or-flight response prepares the body for action. From an evolutionary perspective, this allowed individuals to have the energy to stand their ground and defend themselves (fight) or to remove themselves from danger (flight). The fight-or-flight response is the normal reaction to a situation which is perceived as posing a personal threat or challenge and involves the activation of the sympathetic nervous system.

The fight-or-flight response involves both the upper (cortex) and lower (sub-cortex) portions of the brain. The higher centres use judgement and past experience to recognize the stimulus as threatening or non-threatening, influencing perception and reaction to the stressor. The lower centres are involved in control of heart rate, breathing rate and depth, body temperature, and are involved in the emotional response to a stressor. While the emotional response to stress may vary widely, the physiological response to a stressor is always the same.

Stress reactivity, although very complex, involves two basic components: an endocrine (hormone) response, and a nervous system response mediated through the autonomic nervous system. Key to the endocrine response is the hypothalamus. The posterior hypothalamus activates the adrenal medulla via a direct nervous connection, stimulating the production of epinephrine (adrenalin) and norepinephrine (both stimulatory endocrines). The anterior hypothalamus, through the release of endocrines, stimulates the adrenal cortex to secrete glucocorticoid and mineralocorticoid hormones such as cortisol and aldosterone, and the thyroid gland to produce thyroxin. Along

with the sympathetic nervous system these reactions ready the body to expend energy.

Activation of the sympathetic nervous system and the release of epinephrine are associated with an increased heart rate and cardiac output with a distribution of blood to the muscle's rather than other organ systems, and a release of glucose and free fatty acids into the blood stream to be used as a fuel source to support the increased metabolism. During periods of elevated epinephrine there is an increased force of muscle contraction both in skeletal and heart muscle tissue, with increased muscle tone and metabolism. With increased heart contractility blood pressure goes up ensuring adequate blood flow to the working tissues, while platelet aggregation occurs to increase the coagulability of the blood should injury occur. The bronchiole tubes also dilate making it easier to breathe, enhancing the ventilation of the lungs, ensuring adequate oxygenation of the blood.

The release of cortisol and thyroxin influence metabolism. In particular, cortisol secretion stimulates the breakdown of proteins which are used to produce glucose (via the liver) and supply amino acids for tissue repair should injury occur. Cortisol is also important in maintaining blood pressure by increasing vascular reactivity, but is also associated with a depressed immune response by decreasing the number of circulating white blood cells and antibody production. While these reactions may be of great value in the short term, prolonged cortisol secretion under chronic stress conditions may have many deleterious effects (Saplosky, 1992).

Should the stress be repeated or continue for some time, becoming chronic, the person uses coping mechanisms to try to adapt to the situation during what Selye (1956) termed the "stage of resistance". During this period the acute alarm reactions have dissipated, but a chronic overproduction of glucocorticoids (i.e. cortisol) occurs. The overproduction of glucocorticoids suppresses the production of insulin, calling upon stored metabolites to fuel the energy demands, leaving the individual prone to fatigue and illness, with the individual entering Selye's "stage of exhaustion". Prolonged overproduction may have detrimental effects on memory, learning, cognitive function and sleep, as well as suppressing the immune system (Arnsten, 1998). For this reason it is not surprising that researchers have found prolonged or chronic stress to be associated with a high incidence of illness, absenteeism and burnout (Kirkcaldy *et al.*, 1995; Burke, 1994; Brown and Campbell, 1990; Vena *et al.*, 1986; Violanti *et al.*, 1986; Alkus and Padesky, 1983; Nordlicht, 1979; Modlin, 1978). Police work has been associated with a variety of stress-related physical and mental ailments, leading to premature deaths from a variety of causes (Quaile Hill and Clawson, 1988) (although increased mortality has been widely debated and is fraught with methodological problems (Terry, 1981)). Vena *et al.* (1986) found police officers to have higher rates of mortality from suicide, digestive cancers, colon cancer, and cancer of lymphatic and hematopoietic tissues (bone marrow). Vena *et al.* (1986) also report an increased risk of heart disease, related to years of service, and increased all cause mortality for officers over 40 years of age.

Each of the physiological responses to a stressor can be referred to as a symptom of stress, and is manifested in many of the body's organ systems. The common symptoms of stress are outlined in Table I, as are the common ways we recognize these symptoms. It is important to remember that what we recognise as stress (symptoms) is the accumulated effect of all stress reactions. For example, high blood pressure is a result of an increase in heart rate (sympathetic nervous system, epinephrine and thyroxin), increased contractility of the heart muscle (sympathetic nervous system and epinephrine), increased vascular reactivity (cortisol) and fluid retention (aldosterone).

Police officer stress

Research clearly demonstrates that police officers encounter many sources of physical stress (Anderson *et al.*, 2001; Bonneau and Brown, 1995). It has also been reported that police officers experience (or at least believe they experience) high levels of psycho-social stress (Anshel, 2000; Brown and Grover, 1998; Anshel *et al.*, 1997; Violanti and Aron, 1995; Burke, 1994; Sewell, 1981). Physical stress is encountered during tasks of a physical nature, including standing, walking, climbing stairs, manipulating objects, twisting, turning, pushing, pulling, running, bending, squatting, kneeling, lifting and carrying. In a laboratory setting the heart rate will go up in relation to the intensity of a physical activity, with the relationship between workload and heart rate being linear throughout the majority of the heart rate range from rest to maximal exercise. In police work we can expect the same relationship to exist, being modified by the situational demands and perception and cognitive appraisal of the situation – psycho-social stress.

For our purposes psycho-social stress is the response of an individual to the self-perceived imbalance between the demands of the situation presented, and the resources one has at their disposal to respond successfully (Eden, 1990). Psycho-social stress is a function of the individual's appraisal and interpretation

Organ system	Symptom	Sign
Cardiovascular	Increased blood pressure	Flushed appearance
	Increased heart rate	Racing heart rate Palpitations
Muscular	Increased tension	Stiff neck
		Grinding teeth
		Headaches
Digestive	Increased motility	Gas/burping Diarrhea
	Increased acid secretion	Indigestion/heartburn Nausea
	Reduced salivary secretion	Dry mouth
Integument	Increased glandular secretion	Perspiration
		Oily skin Body odour

Table I.
Some of the common signs and symptoms of stress

of one or more events, either real or imagined (Anshel, 2000; Biggam *et al.*, 1997; Lazarus and Folkman, 1984). The stressfulness of the situation will depend on the person's assessment and perception of the difference between the demands of the situation and their ability to meet those demands.

Psycho-social stress may be acute or chronic. Acute stress is derived from events that have a sudden onset of a critical nature, with the situations resolved in a short duration. Situations that cause acute stress are often referred to as critical incidents, being situations that overwhelm the individual's coping skills (Kureczka, 1996) and result in immediate distress (Evans and Coman, 1993). Critical incidents are sudden, powerful events that often expose the officer to dangerous situations that are perceived as being outside of the officer's immediate control. Spotting a stolen vehicle, responding to a Code 3, a high speed chase, conflict with a suspect, entering a household with a crime in progress, or technical difficulties with equipment essential to job performance are among the plethora of examples of situations that can elicit an acute stress response in police officers.

Chronic stress is stress that builds over time and does not resolve itself quickly. Chronic stress may not lead to immediate distress, but depends on the person's ability to cope, and the coping strategy employed (Anshel, 2000; Haarr and Morash, 1999; Biggam *et al.*, 1997; Burke, 1994; Evans and Coman, 1993; Graf, 1986). Sources of chronic stress are often cited as being of two sources – organizational or structural sources, and those internal or inherent in the job (Storch and Panzarella, 1996; Violanti and Aron, 1995; Burke, 1994; Terry, 1981). Factors within the organization and organizational structure that can cause distress include lack of administrative support, the promotion process, inadequate training or equipment, excessive paperwork, intra-departmental politics, and frustrations with the criminal justice system and court leniency (Violanti and Aron, 1995; Kirkcaldy *et al.*, 1995; Burke, 1994; Kirkcaldy, 1993; Martelli *et al.*, 1989; Anson and Bloom, 1988; Terry, 1981). Factors internal or inherent in the job may cause acute or chronic stress. Some of those factors often related to chronic stress include shift work, work overload, anticipation of critical incident response, fear of danger or concerns of personal safety, time management and work-home conflicts (Violanti and Aron, 1995; Burke, 1994; Anson and Bloom, 1988; Terry, 1981; Sewell, 1981).

Psycho-social stress

Imagine this scenario: a police officer responds to a Code 3 emergency, a robbery in progress, involving two armed suspects. He (or she) is only a few blocks away. As the officer turns on the lights and siren, his mouth is dry, his heart races, he feels tension in his shoulders. As he drives, his breathing becomes rapid, and he is already perspiring. Before the officer gets out of the car or performs any physical activity, his body is preparing for what may lie ahead, and the potential demands that may be placed upon it. This reaction is described by Cannon (1932) as the fight-or-flight response. People recognize this physiological response as stress.

Stress, however, is difficult to define and the word has been used to describe various aspects of the stressor – stress reactivity response. The term “stress” has been used to make reference to the stimulus that causes the stress response, the stress response itself, the stimulus-response interaction, or even the whole spectrum of interacting factors (stimulus, cognitive appraisal, perception, and coping style) related to the stimulus and response (Anshel *et al.*, 1997; Violanti and Aron, 1995). For example, the anticipation of what the officer will find upon arriving at a critical incident is the stimulus for the fight-or-flight response and is often referred to as stressful; however, for our purpose this will be defined as the stressor. The physiological phenomena that prepare one for action have also been referred to as stress; however, for our purpose this will be referred to as stress reactivity. Stress reactivity, or the response exhibited in response to the stressor (see Figure 1), will vary between individuals depending on their personal attributes, perception and cognitive appraisal of the situation, their coping strategies, and their social support network (Anshel, 2000; Biggam *et al.*, 1997; Violanti and Aron, 1995; Lazarus and Folkman, 1984). For this reason, as implied in the introduction, two people may have very different reactions to the same event or stressor – one may perceive the situation as threatening and exhibit signs of stress reactivity, while another may perceive the situation as non-threatening and not exhibit signs of stress reactivity.

For our purposes stress is defined as a combination of a stressor and stress reactivity, encompassing a stimulus and a response. In this definition a stressor has the potential to elicit a stress reaction, depending upon the perception of threat and the person’s ability to cope. Many variables, including personal attributes, cognitive appraisal, coping strategy and social support, may modify stress reactivity in any given situation, and can account for the different response of two individuals exposed to the same stressor.

Personal attributes. Several personal attributes have been associated with stress-reactivity. Anshel (2000) found officers who maintained “a heightened

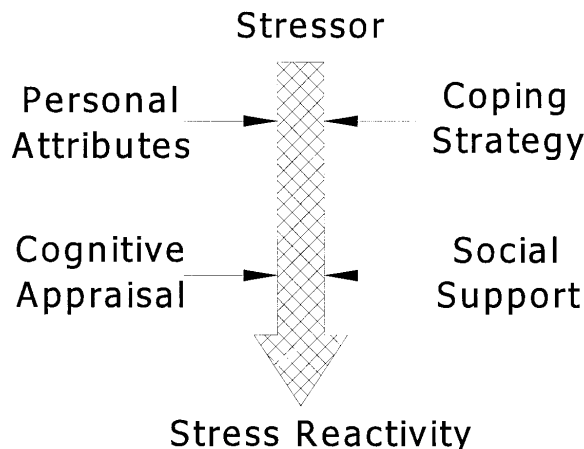


Figure 1.
Overview of stress and
modifiers of stress
affecting the stressor to
stress reactivity
pathway

cynicism, pessimism, neuroticism, perfectionism, and reduced hardiness” (p. 396) were more susceptible to high perceived stress and increased tension. Optimism has been associated with task-oriented behaviour, while optimists have been found to emphasize the positive aspects of a situation and seek out the appropriate social support (Scheier *et al.*, 1986). Hardiness is associated with perceived control, and is associated with the ability to resist stress. For example, Tang and Hammontree (1992) found hardy police officers to have lower absenteeism than non-hardy police officers, and hardy low-stress officers to have less absenteeism than hardy high-stress officers. These authors caution, however, that some of the extreme stress that can be experienced in policing may over-ride the modest contribution of individual differences to reduced stress.

Cognitive appraisal. Differences in perception and cognitive appraisal are often seen in threatening, alarming or emotional situations, leading to differences in stress reactivity (Anshel, 2000; Anshel *et al.*, 1997; Violanti and Aron, 1995). In Anshel’s conceptual model for coping with police stress (Anshel, 2000), the first step in the stressor response is the perception of an event or detection of a stimulus. All psycho-social stress involves an interaction between an individual and their environment and first involves the individual’s appraisal of the situation at hand and their perception or detection of the stressor or stimulus (Klein, 1996). This process involves selective attention, attending to those factors providing useful information while filtering input that is predetermined as meaningless (Anshel, 2000). If an event is not processed or the stimulus is ignored, it cannot cause stress reactivity.

One’s cognitive appraisal of a situation will mediate its stressfulness, modifying the quality and intensity of the emotional and physiological response. Lazarus and Folkman (1984) suggest that an individual’s perception of stress will be dictated by their interpretation of the situation presenting itself as either threatening, harmful or challenging. In studying Swedish police officers, Larson *et al.* (1988) found officers to perceive situations as challenging more often than threatening, suggesting that the situations were perceived as controllable or solvable. Further, these challenge appraisals were related to better job performance than threat or harm/loss appraisals, allowing officers to remain task-oriented, confident and alert. Peacock *et al.* (1993) found challenge appraisals to be related to problem-focussed coping, common to conditions perceived as controllable, whereas threat-appraisals were related to emotion-focussed coping, common in situations perceived as uncontrollable. The cardiovascular and endocrine response to high stress during situations which are perceived as controllable and uncontrollable were studied by Peters *et al.* (1998), finding uncontrollability to be associated with higher blood pressure, norepinephrine and cortisol levels.

Coping strategy. Coping is the conscious use of cognitive or behavioural strategies to reduce perceived stress (Lazarus and Folkman, 1991). Lazarus and Folkman (1984) described “problem-focussed” and “emotion-focussed” coping strategies. More recently Anshel (2000) described “approach” and “avoidance”

coping strategies. Problem-focussed and approach coping strategies typically involve information gathering in an attempt to control or better understand the situation at hand, and are used most often when situations are perceived as amenable to change and control (Anshel, 2000; Anshel *et al.*, 1997; Lazarus and Folkman, 1984). Problem-focussed or approach coping strategies confront the source of stress, hoping to control the situation or improve one's resources available to combat the stress through personal empowerment (Anshel, 2000; Dewe, 1993). Emotion-focussed or avoidance coping strategies are typical when the situation is perceived as being beyond one's capacity, or low-control situations. These coping strategies include cognitive efforts to change the meaning of the situation, avoiding unpleasant thoughts by distancing one's self from the situation, or re-interpreting the information in a more positive light. According to Anshel (2000), emotion-focussed or avoidance coping allows a police officer to maintain attentional focus and move on to the next task. Coping strategies have been related to the cognitive appraisal of a situation (Peacock *et al.*, 1993; Larson *et al.*, 1988), while several studies have investigated the use of coping strategies by police officers (Anshel, 2000; Haarr and Morash, 1999; Anshel *et al.*, 1997; Biggam *et al.*, 1997; Kirkcaldy *et al.*, 1995; Burke, 1994).

Several studies have found police officers possess maladaptive avoidance coping behaviours (Richmond *et al.*, 1998; Burke, 1994; Evans and Coman, 1993; McCafferty *et al.*, 1992; Graf, 1986). Richmond *et al.* (1998) found a high prevalence of excessive alcohol consumption among officers, while high levels of divorce and suicide have been related to a failure to cope (Evans and Coman, 1993; McCafferty *et al.*, 1992). The use of alcohol, drugs, cigarettes, and physical isolation from others were all reported as coping mechanisms utilized by police officers (Burke, 1994). In fact, Graf (1986) found that two-thirds of the police officers sampled rarely dealt with work hassles, and did not feel confident in their ability to cope with work-related problems. These results are supported by a comparison of police officers and the general public (Westernick, 1990) which found police officers to have more frequent and more severe psychological and physical disturbances. While there is a paucity of literature examining coping strategies in police officers, the evidence of maladaptive coping behaviours used for immediate stress reduction suggests a need for developing coping strategies in police personnel.

Social support. Social support may come from within the police organization, or from external sources such as friends and family. However, there are mixed views on the importance of the role of social support in police stress. For example, Kirkcaldy *et al.* (1995) found police officers tend to rely significantly more on social support mechanisms in their coping, including seeking advice from supervisors, talking to family and friends, as compared to the general population. While intuitively one would think that increased social support is important in reduced stress, Coyne and Downey (1991) suggested that this may not be the case. The role of social support in moderating the stressor response may well be determined by the stress conditions under which one is working. For example, Brown and Grover (1998) suggest that the role of moderating

variables, such as social support, operate differently under conditions of high and low stress exposure. Gender may also influence the role of social support in moderating the stress response, with females reporting a higher use of social support strategies as coping mechanisms (Biggam *et al.*, 1997).

While the role of family and friends as moderators of stress reactivity is still controversial or unclear, there is an abundance of evidence pointing to the deleterious effects of a lack of social support from the organization (Anshel, 2000; Haarr and Morash, 1999; Biggam *et al.*, 1997; Storch and Panzarella, 1996; Hart and Wearing, 1995; Kirkcaldy *et al.*, 1995; Violanti and Aron, 1995; Burke, 1994; Kirkcaldy, 1993; Martelli *et al.*, 1989; Alkus and Padesky, 1983; Terry, 1981). Further, while training has been initiated in many police jurisdictions to help police officers identify and cope with stress, few have looked toward institutional or organizational reform. While the impact of institutional reform on occupational stress may have been studied in diverse occupations, there are few studies directed specifically towards policing. From the literature, however, one could hypothesize that increased social support from within the organization in terms of leadership, trust, open communication, a more consultative management style, and more administrative support, could go a long way in reducing police stress (Finn, 1997).

Psycho-social stressors

The entire matter of stressors and particularly the identification of stressors is incredibly complicated. A stressor is anything that leads to stress reactivity. Stressors are situations which, when compared to past events, are generally perceived as threatening or challenging. The reaction to a stressor is therefore individual and situational (Peters *et al.*, 1998; Dewe, 1993). Some people find viewing a dead body at a funeral stressful, while police, doctors and nurses may not as they are accustomed to seeing dead bodies that are not cleaned and well presented. Each group of people has a different reaction to a dead body; one perceives it as stressful, and the other does not based upon past experience. Viewing the body of a close friend or child, however, may change the stress reaction.

In the policing literature researchers have generally neglected to study sources of stress, but instead focused on the effects of chronic stress (Anshel, 2000; Evans and Coman, 1993). Studies which have examined police officer stressors used the 60 item Police Stress Survey developed by Spielberger *et al.* (1981) (Violanti and Aron, 1995; Tang and Hammontree, 1992; Martelli *et al.*, 1989), the Occupational Stress Indicator (Biggam *et al.*, 1997; Kirkcaldy *et al.*, 1995; Kirkcaldy, 1993) and the Perceived Stress Index (McLaren *et al.*, 1998). While each has provided valuable information, these studies are based on self-report questionnaire data and as such, only provide an indication of perceived stress. Further, questionnaires have often neglected to measure the frequency of occurrence of the stressor (Anshel *et al.*, 1997; Terry, 1981). For example, studies using the Spielberger Police Stress Survey have found that “killing someone in line of duty” and “fellow officer killed” are the most stressful events encountered by a police officer (see Violanti and Aron, 1995); however, the

stress is implied as few if any of the officers surveyed would have encountered such a situation. While killing someone in the line of duty may be classified as the most stressful event encountered by a police officer, it is one of the most infrequent. Frequency data is important to determine those stressors which may have the greatest impact on the officers during their day-to-day duties (interestingly Spielberg *et al.*'s (1981) original questionnaire development included frequency data) (Violanti and Aron, 1995), given frequency and intensity data clearly measure different dimensions of the stressor response (Anshel *et al.*, 1997).

Repression

The entire matter of measuring stressors is further complicated by the issue of repressors. Repressors are defined as persons "manifesting heightened recognition thresholds for anxiety-provoking stimuli" who report little tendency to become anxious (Weinberger *et al.*, 1979, p. 379). These individuals can be identified as having low Taylor Manifest Anxiety Scale and high Marlowe-Crowne Social Desirability Scale scores (Newton and Contrada, 1994; Weinberger *et al.*, 1979). Under high stress situations repressors will exhibit an increased physiological response as dictated by the autonomic nervous system without a concomitant increase in self-report measures of negative affect (Newton and Contrada, 1994).

In stress-related literature using self-report anxiety and stress scales there is a need to differentiate between people who are truly low-anxious people and repressors. People with repressive coping styles will typically deny being stressed and anxious (Weinberger *et al.*, 1979). Given that police training emphasizes controlling emotions (Brown and Grover, 1998), projecting strength and authority without displaying emotion (Sewell, 1981), one must expect to find repressors that self-report normal levels of stress when responding to questionnaires in police officer research. While there is no direct evidence to support this claim, there is an abundance of research reporting maladaptive or repressive-type coping styles (Haarr and Morash, 1999; McCafferty *et al.*, 1992, 1990; Terry, 1981; Blackmore, 1978). For example, Terry (1981) and Blackmore (1978) report police officers seek out and/or utilize significantly less mental health support than the average public, while Haarr and Morash (1999) report the use of escape as a coping mechanism with police officers exhibiting strong negative attitudes toward emotional expression (Brown and Grover, 1998).

Should police officers exhibit repressive behaviour and repressive coping styles, self-report data from such individuals may be difficult to compare to others. In fact, not accounting for this tendency may well explain some of the comparative literature that reports police officers to have normal stress levels (see McLaren *et al.*, 1998; Hart and Wearing, 1995; Anson and Bloom, 1988). There is a distinct need for research examining repressive behaviour, self-report stress and stressors, while collecting physiological data to see if repressors have a physiological response that exceeds the self-report negative affect.

Purpose of the present study

While prior research in policing points to sources of stress and is consistent with the common sense assumption that police work is stressful, it is based largely on self-report data from police officers. As such it only tells us what police officers perceive to be stressful and what they perceive to be sources of stress. With this in mind, this study was initiated primarily as an attempt to find physical evidence for reported levels and sources of police officer stress. Physical evidence as measured by heart rate, matched to observed data collected through ride-alongs with police officers, were used to quantify stress reactivity. The extent to which the heart rate of officers differed from one physical activity to another and, more importantly, how the rate changed in relation to non-physical activities were examined. Further, the study examined how heart rates changed over the course of a shift for the ten officers studied who were involved in critical incidents.

Method

Heart rate is a primary indicator of autonomic nervous system activation, as experienced during stress (HeartMath, 1999). Heart rate is used in the present study, along with data concerning physical activity, to differentiate between physical stress and psycho-social stress. The heart rate and physical activity data upon which the present study is based was collected as a sub-component of an earlier study of the physical requirements of police work conducted in 1998 and 1999 (Anderson *et al.*, 2001). That study involved a systematic random sample of 297 general duty police officers drawn from all 12 municipal police departments in British Columbia. The officers were surveyed (through two separate questionnaires) about the physical aspects of their job and about the most demanding critical incident of their prior 12 months of work. A total of 287 officers (96 percent) responded to the survey (Anderson *et al.*, 2001).

One component of the study (and one directly relevant here) involved asking every other officer surveyed to participate in a researcher ride-along exercise. The exercise required a research assistant to observe and record all activities performed by the officer. Specifically, using detailed tracking sheets, the research assistant recorded all instances of each of 30 different activities occurring within each minute of each shift, beginning from the time the officer left the briefing at the start of the shift, through to the attendance in the locker room at the end of the shift. Data were collected on as many as 720 minutes per 12 hour shift and as many as nine activities per minute. Overall, data were collected during 121 ride-alongs over a 12 month period, providing a total of 75,867 minutes of observation (Anderson *et al.*, 2001).

The present study involved each of the 121 officers in the ride-along exercise being fitted with a heart monitor which recorded every heartbeat. The monitor was activated the minute the research assistant began to record observations of physical activity at the beginning of the shift. The heart rate data were downloaded into lap-top computers at the end of the shift. The data were later converted to an SPSS version 10.0 data set and merged with the observed data.

This merge enabled the researchers to match each minute of heart rate data with an associated minute of observed data. Accordingly, the researchers were able to determine precisely what each officer's heart rate was during any single activity (or any combination of activity) throughout their shift.

One issue which arose in the collection of the heart rate data was the reliability and dependability of the monitors used in the first part of the study (Polar Electro Advantage). Electro magnetic activity in the patrol cars would cause the monitor to fail periodically, leaving gaps in the data. While this problem did not occur on every ride-along, it occurred enough times early in the study that a decision was made to switch to a more sophisticated monitor (Polar Electro R-R Recorder). Unfortunately though, acquiring an appropriate replacement monitor took some time – they did not arrive until 71 ride-alongs had been completed. In the end the researchers decided to exclude those cases with missing data, leaving 76 cases for the present analysis. The characteristics of this reduced sample, however, remained remarkably similar to those of the 121 officers selected for the ride-along exercise (see Table II). As reported elsewhere (Anderson *et al.*, 2001), the characteristics of this sub-group match those of the main group of 267 officers participating in the study. Further, the researchers are confident that this group is a very good representation of police officers involved in municipal policing in British Columbia (Anderson *et al.*, 2001), and hence are confident that the reduced sample of 76 also constitutes a representative sample.

The results reported in this paper focus on an analysis of each officer's heart rate, which is reported in two ways: above-resting heart rate and percentage of heart rate reserve. Above-resting heart rates standardize for variations in resting heart rate by taking the difference between the officer's actual heart rate and their resting heart rate, defined as the lowest heart rate observed over the

Characteristics considered	Ride-along sample (N = 121)	Reduced sample (N = 76)
Age (years)	34	33
Female officers (%)	21	19
Height (cm)	178	179
Weight (kg)	82	83
Weight of equipment (kg)	9.6	9.6
Months in present position	46	49
Always worked with a partner (%)	41	46
Sleep prior to shift (hours)	6.7	6.8
Hours awake prior to shift (hours)	4	5
Difficulty in getting to sleep (%)	26	20
Tired at beginning of the shift (%)	37	36
Tired at the end of the shift (%)	69	75
Length of shift (hours)	11	11

Table II.
Selected characteristics
of patrol officers
sampled/included in
the analysis

course of the shift. For example, a heart rate of 80 beats per minute may be resting heart rate for one officer, while being as much as 35 beats above rest in another. To standardize for age-related changes in heart rate (maximum heart rates decrease with age), and to understand the relationship between working heart rate and maximum potential, percentage of heart rate reserve is also reported. This expresses the working heart rate as a percentage of the potential increase in heart rate (heart rate reserve = maximum heart rate – resting heart rate). Maximum heart rates were predicted by subtracting one’s age in years from 220 (maximum heart rate = 220 – age). While this method has a standard deviation of ten to 12 beats per minute, one can expect some people to have an actual maximum heart rate above this, and some below this, and as such someone working at their true maximum heart rate may well have a percentage of predicted heart rate reserve in excess of 100 percent.

Results

Table II reports the characteristics of both the total sample of officers involved in the ride-along portion of the study and those for whom complete heart rate data are available. The average resting heart rate for the 76 officers involved was 59 beats per minute. As they went about their work during their shift, their heart rate averaged 82 beats per minute. In other words, their average above resting heart rate during their shift was 23 (i.e. 82 – 59) beats per minute. Furthermore, on average, the above resting heart rate was generally highest at the beginning of the shift and the lowest at the end. As Table III demonstrates, for example, the average above resting rate was 25 beats per minute over the first hour of the shift and only 19 beats per minute in the last hour. These results are consistent with a view that officers may suffer some degree of anticipatory stress when beginning their shift.

The officer’s heart rate during those physical activities which represent the core of bona fide occupational physical requirements of police work (Anderson *et al.*, 2001) are presented in Table IV. As expected, those activities that are more physical in nature and involving larger muscle masses generate the highest above resting heart rates. As Table IV indicates, the highest above

	Above-resting heart rate		Percentage heart rate reserve	
	Mean	SD	Mean (%)	SD (%)
First 15 minutes	29	14	22	10
First 30 minutes	27	13	21	10
First 45 minutes	26	13	20	10
First 60 minutes	25	13	20	9
Last 60 minutes	19	12	15	10
Average for entire shift	22	12	17	9

Table III.
Officer’s average above-resting heart rate and percentage of heart rate reserve used during the shift

Note: Excludes the ten officers who were involved in a critical incident over the course of the shift

Table IV.
Patrol officer's above-resting heart rate and percentage of heart rate reserve used during selected physical activities

Activity considered	Above-resting heart rate ^a		Percentage heart rate reserve	
	Mean	SD	Mean (%)	SD (%)
Sitting	20	11	15	9
Standing	27	13	21	10
Walking	32	15	25	11
Bending	32	15	25	11
Lifting	35	18	27	13
Climbing stairs	34	15	27	12
Squatting/kneeling	39	23	30	17
Twisting	37	18	28	14
Pulling/pushing	49	25	38	19
Running	35	23	27	18
Climbing objects	37	15	29	11
Jumping	28	12	22	10
Average during full shift	23	13	18	10

Note: ^aMean resting heart rate was 59 beats per minute

resting heart rate appeared when officers were pushing and pulling. This is consistent with the literature on arm exercise which demonstrates a greater heart rate and blood pressure response to upper body exercise as compared to exercise using the lower body (Powers and Howley, 2001).

The officer's heart rate during selected use of force activities are presented in Table V, and provide the first indication that officers experience psychological stress as well as physical stress in their work. As expected, the average above-resting heart rate for activities such as tussling, wrestling, and fighting were high as they should be given the intense physical nature of these activities. The average above-resting heart rate is also relatively high for handcuffing – to be expected since it is an activity which sometimes immediately follows intense physical activity. Interestingly though, the above-resting heart rate was relatively high when an officer placed his or her hand on a holstered gun, with

Table V.
Patrol officer's above-resting heart rate and percentage of heart rate reserve used during selected use of force and related activities

Activity considered	Above-resting heart rate			Percentage heart rate reserve		
	Mean	Max	SD	Mean (%)	Max (%)	SD (%)
Tussle	58	107	25	46	85	19
Wrestling	65	97	25	51	73	20
Full fight	54	112	50	43	85	37
Handcuffing	45	88	23	34	72	18
Hand on gun, no suspect present	29	52	15	15	29	8
Holster snap open, no suspect present	45	49	5	31	31	0
Hand on gun, suspect present	40	52	9	31	43	7
Holster snap open, suspect present	49	49	0	35	35	0
Average during full shift	23	93	12	18	95	10

higher above-resting heart rates when the officer opened the snap to the gun holster. Further, whether it was a hand on the holster or a further step of opening the holster snap, the above-resting heart rate was higher when a suspect was present, clearly demonstrating the anticipatory stress response or anxiety.

Additional evidence that police officers experience psychological stress were also found in an assessment of their above-resting heart rate during various driving activities. There were significant differences between the above-resting heart rate between Code 1, Code 2, Code 3 and minor and major pursuits in driving, with the above-resting heart rate increasing as the severity of the pursuit increased (see Table VI). Equally significant, and further evidence of anticipatory stress, is the fact that regardless of the Code level, officers providing “back-up” had higher above-resting heart rates than those assigned to a call.

An analysis of the officer’s heart rate prior to, during, and after a critical incident is presented in Table VII. As expected, officers who encounter a critical incident experienced elevated heart rates. Specifically, the average above-resting heart rate and percentage of heart rate reserve used during a critical incident were elevated for each of the number of activities considered, from the average rates apparent 30-60 minutes prior to the incident. As expected, the rate dropped with recovery after the critical incident; however, unexpectedly, the rates did not return to their previous level. Rather, officers maintained elevated rates 30-60 minutes after the critical incident in all of the activities considered (again see Table VII). Talking to a suspect after experiencing a critical incident elicited the highest heart rates (virtually double, or +23 beats per minute) above pre-incident levels, maintaining a state of

Activity considered	Above-resting heart rate ^a		Percentage heart rate reserve	
	Mean	SD	Mean (%)	SD (%)
Idling – Watching	18	101, 112	14	8
– Traffic violation	21		16	8
– Suspicious vehicle	22		17	9
Normal driving	19	11	15	9
Code 1 (assigned)	20	910	15	7
(back up)	21	13	16	17
Code 2 (assigned)	25	1,112	18	8
(back up)	27		21	9
Code 3 (assigned)	28	1,710	21	13
(back up)	41		32	7
Minor pursuit	17	1,043	14	8
Major pursuit	41		31	5
Average for full shift	23	13	18	10

Note: ^aMean resting heart rate was 59 beats per minute

Table VI.
Patrol officer’s above-resting heart rate and percentage of heart rate reserve used during selected driving activities

Table VII.
Patrol officer's above-resting heart rate (HR) and percentage heart rate reserve (% HR) prior to, during and after a critical incident

Activity considered	30-60 mins prior		During a critical		30-60 mins after	
	HR	% HR	HR	%HR	HR	%HR
Talking to suspect	22	20	52	40	45	35
Talking to police	22	17	44	34	39	31
Talking on radio	18	15	47	37	37	29
Using mobile data terminal	14	12	103	79	37	30
Normal driving	23	18	35	28	38	29
Getting into the car	29	23	85	69	40	31
Standing	33	26	48	38	46	35
Sitting	20	16	29	23	32	25
Average for all activities	26	20	45	35	38	30

Note: Figures are based on the heart rate activity of ten male patrol officers who had an average resting heart rate of 62 beats per minute, and an average above-resting heart rate of 29 beats per minute over the entire shift

hyper-vigilance. Considering all activities, the average above-resting heart rate 30-60 minutes after the critical incident was +12 beats higher than the average above-resting heart rate 30-60 minutes prior to the critical. Further, there was evidence that this state of hyper-vigilance remains throughout the remainder of the shift (see Table VIII). Officers who encountered a critical incident during their shift had elevated heart rates throughout the remainder of the shift, leaving their shift with heart rates plus nine beats per minute higher than those who did not experience a critical incident.

The results suggest that police officers experience anticipatory stress when coming to work (from undetermined sources). Police officers, once in uniform, have an elevated heart rate (+29 beats per minute over rest). While the officers' above-resting heart rate averaged +22 beats per minute over the entire shift, the rate actually declined over the shift. Officers not involved in a critical incident left the shift with an average above-resting heart rate of +20 beats per minute, decreasing nine beats per minute over the shift.

Table VIII.
The police officer's above-resting heart rate and percentage of heart rate reserve during selected activities in the last hour of the shift, comparing officers who were and were not involved in a critical incident

Activities considered	Above-resting heart rate		Percentage heart rate reserve	
	Not critical	Critical	Not critical (%)	Critical (%)
Talking to suspect	24	35	18	26
Talking to police	19	31	14	25
Talking on radio	19	26	15	22
Mobile data terminal use	22	23	14	18
Getting into the car	27	31	21	24
Normal driving	18	27	13	21
Walking	32	37	25	29
Standing	21	31	16	25
Sitting	16	25	12	20
Writing	20	28	16	22
Average of all activities	20	29	15	23

Discussion

The results of this study demonstrate the increased physiological stress one would expect during physical activities of increased intensity, particularly that stress which occurs during the escalating use of force activities. Further, the results clearly demonstrate the psycho-social stress of police work with increased physiological reactions during situations where there is potential threat, and during periods of anticipation. The stress reactivity during periods of increased threat are evidenced in the increased heart rates during different posturing activities (hand on holstered gun) and during periods of communication with suspects. Anticipatory stress is evidenced in the high above-resting heart rates at the beginning of the shift, and the high above-resting heart rates of officers called in back-up roles to critical incidents. This data is consistent with that of Anshel *et al.* (1997) who rated facing unpredictable situations as the most stressful acute stressor.

The present study found the highest physical stress to occur during pushing and pulling and fighting sequences when the largest proportion of the musculature was active. However, police officers responding to critical incidents also demonstrated marked psycho-social stress and stress reactivity, being most notable during the interaction with a suspect both during the critical incident, and then during each subsequent interaction with suspects for the remainder of the shift. These results are consistent with those of Anshel *et al.* (1997) and Peters *et al.* (1998) who both report high levels of acute stress in situations with high demand and low control (such as dealing with a domestic dispute or arresting a violent suspect). However, the findings of the present study also found police officers involved in observed critical incidents did not recover. The mean above-resting heart rate of those involved in a critical incident remained elevated for the remainder of the shift for all tasks, including a significantly elevated heart rate during report writing (plus eight beats per minute greater than those not in a critical incident) in the last hour of the shift.

Researcher assistants observed a number of incidents of high stress that were not considered critical incidents. Some of these only lasted a minute or two: ten (13 percent) of the 76 officers reached 75 percent of their heart rate reserve at some point during their shift, indicating a significant level of stress; seven of these ten officers did so during or after a critical incident, but three were spontaneous events. For example, during a traffic violation stop, an officer radioed a fellow police officer after talking to a suspect, returned to his vehicle to use the mobile data terminal, and immediately attained 88 percent of his heart rate reserve. This is an example of psycho-social stress, and may well be explained by a reassessment of the situation from a challenge or benign appraisal to threat appraisal. In another incident, an officer responded to a suspicious package thought to be a bomb. In this case the officer suffered an acute stress response each time he retold the story: an increase of 36 beats a minute above rest when informing his supervisor of the situation, after his initial appraisal of the situation (62 percent of the initial response), and almost as high when re-telling the story at the end of the shift.

While our results show a clear indication of the initiation of the fight-or-flight response, Simeons (1951) suggested that the fight-or-flight response is not compatible with our industrialized world; it is not appropriate to run from an antagonistic suspect, or fight a superior for asking you to do something you are not fond of. While the fight-or-flight response may be essential to survival in a predatory situation (as the hunter or hunted), the survival value for humans has diminished in the civilized world, and may be counter-productive. When the fight-or-flight response is initiated, but not acted upon, there is a psychology-physiology mismatch – our bodies are ready for action, but action is inappropriate. The stress products released are then left to break down the body, and may be one link between stress and disease.

The sustained heart rates of 22 beats per minute above rest throughout the shift demonstrates the chronic stress placed upon police officers. Further, many of the abrupt increases in heart rate are not associated with physical effort, which may be more harmful to one's health. While the relationship between stress and disease has been postulated for centuries, dating back to the early Greek philosophers, scientific evidence supporting the relationship has not been available until recently. The early body of literature examining stress and disease made wide sweeping statements supporting the notion that stress has a cumulative effect, somewhat independent of the stressor, with the frequency, duration and intensity of stressful events correlated to ill-health (Modlin, 1978). More recent evidence is more specific, and suggests that effort without distress may be related to catecholamine secretion, while increased cortisol secretion was related to negative affect, emotion or distress (Frankenhaeuser, 1991). Further, while subtle increases in cortisol may potentiate the immune response, short term surges or chronic over-production of cortisol are likely to cause immunosuppression (Saplosky, 1992) leaving one prone to illness and disease. This mechanism may describe the relationship between police work and common health problems, as the chronic anticipatory stress at the beginning of a shift (as seen with elevated heart rates) and the psycho-social stress encountered throughout a shift (as documented through increased heart rates without physical activity) may impact on cortisol secretion. Programs directed toward officers' perceptions of control, helping them move from a threat or harm/loss appraisal to a challenge appraisal during periods of acute stress, could have a potential health effect by reducing negative affect and distress, reducing cortisol secretion.

Our results also support the practice of debriefing at the end of shifts or immediately after critical incidents. Participants involved in critical incidents do not appear to handle the stress of critical incidents well, having elevated heart rates 45-60 minutes after a critical; further, these elevated rates stay with them through to the end of their shift. Significantly, this pattern of elevated heart rates was observed regardless of the activity considered, while at the same time it was not observed in those officers who did not experience a critical over the course of their shift. The heart rate response pattern found clearly highlights the need to assist police officers in developing mechanisms to cope

with the stress of critical incidents. Police training programs may be well advised to include discussion of stress and stress-related illness, a self-evaluation of personal attributes that may predispose an officer to stress, and discuss cognitive appraisal and coping strategies to help officers reduce acute and chronic stress. Training programs may also want to look towards the officer's social support network and offer seminars on how to best offer a supportive environment at home and recognize the signs of stress.

Unfortunately, it was beyond the scope of the present study to examine just how long after an officer leaves shift their heart rate remains elevated (if during the shift they were involved in a critical incident). More importantly, what the present research was not able to do is provide data which could shed light on what difference, if any, the slow recovery from critical incidents makes in terms of each officer's short- and long-term health. However, job-related stress found in police work may be theoretically related to ill-health in several ways, with a direct link being supported by the results of several recent investigations. While the present study demonstrated several abrupt increases in heart rate, surges in catecholamines associated with acute stress (e.g. apprehending a known felon) have recently been related to increased incidence of cardiovascular disease (Krantz and Manuck, 1984) with high-demand and low-control situations (such as entering a house where a domestic dispute is in progress) being related to high blood pressure and increased risk of heart attacks (Kelsey *et al.*, 2000; Peters *et al.*, 1998). The surge in catecholamines during acute stress also slows the digestive tract and may be related to cancers of the colon and digestive organs. Further, the nature of police work dictates that police are constantly being observed and evaluated by the public, increases stress appraisals and cardiac reactivity (Kelsey *et al.*, 2000) which may well lead to increased incidence of coronary heart disease and hypertension. Chronic stress and the over-production of cortisol has been linked to the reduction of lymphocytes (white blood cells involved in the immune response) and immunosuppression and other illness. Immune system dysfunction may partially explain the high rate of hospital admissions found in the police population (as reported in Terry, 1981).

Conclusion and future direction

In the final analysis the results of the present study confirm the results of self-report data. The results show that police officers experience both physical and psycho-social stress on the job. The results also demonstrate that they anticipate stress as they go about their work, and in fact, suffer anticipatory stress at the start of each shift. Not surprisingly, the results demonstrate that the highest levels of stress occur just prior to and during critical incidents.

While the raw data suggests that police officers suffer momentary periods of anticipatory stress, many of these were short lived with near resting heart rates being seen within a minute or two. This may occur as a result of the officer's quick cognitive re-evaluation of the moment, satisfying them that the situation is a false alarm and in effect, is nothing to worry about. In any case, these

momentary periods of anticipatory stress, the associated rapid recovering, and the role of cognitive appraisal in that recovering, deserve further research.

Ideally, future research would be able to study police officer stress under a longitudinal design, accounting for the potential repressive behaviours of police officers, with direction from a multi-disciplinary team of psychologists, medical doctors, kinesiologists, and criminologists. Accounting for repressive behaviour is important not only because repressors underestimate the stress they experience, but because they respond less readily and easily to interventions which could help them cope with stress (Newton and Contrada, 1994).

References

- Alkus, S. and Padesky, C. (1983), "Special problems of police officers: stress-related issues and interventions", *Counseling Psychologist*, Vol. 11, pp. 55-64.
- Anderson, G.S., Plecas, D.B. and Segger, T. (2001), "Police officer physical abilities testing: re-validating a selection criterion", *Policing: An International Journal of Police Strategies and Management*, Vol. 24, No. 1, pp. 8-31.
- Anshel, M. (2000), "A conceptual model and implications for coping with stressful events in police work", *Criminal Justice and Behavior*, Vol. 27 No. 3, pp. 375-400.
- Anshel, M.H., Robertson, M. and Caputi, P. (1997), "Sources of acute stress and their appraisals and reappraisals among Australian police as a function of previous experience", *Journal of Occupational and Organizational Psychology*, Vol. 70, pp. 337-56.
- Anson, R.H. and Bloom, M.E. (1988), "Police stress in an occupational context", *Journal of Police Science and Administration*, Vol. 16 No. 4, pp. 229-33.
- Arnsten, A.F.T. (1998), "The biology of being frazzled", *Science*, Vol. 280, pp. 1711-2.
- Biggam, F.H., Power, K.G. and MacDonald, R.R. (1997), "Coping with the occupational stressors of police work: a study of Scottish police officers", *Stress Medicine*, Vol. 13, pp. 109-15.
- Blackmore, J. (1978), "Are police allowed to have problems of their own?", *Police Magazine*, Vol. 1 No. 3, pp. 47-55.
- Bonneau, J. and Brown, J. (1995), "Physical ability, fitness and police work", *Journal of Clinical Forensic Medicine*, pp. 157-64.
- Brown, J.M. and Campbell, E.A. (1990), "Sources of occupational stress in the police", *Work and Stress*, Vol. 4, pp. 305-18.
- Brown, J. and Grover, J. (1998), "The role of moderating variables between stressor exposure and being distressed in a sample of serving police officers", *Personality and Individual Differences*, Vol. 24 No. 2, pp. 181-5.
- Burke, R.J. (1994), "Stressful events, work-family conflict, coping, psychological burnout, and well-being among police officers", *Psychological Reports*, Vol. 75, pp. 787-800.
- Cannon, W.B. (1932), *The Wisdom of the Body*, W.W. Norton, New York, NY.
- Coyne, J. and Downey, G. (1991), "Social factors and psychopathology, stress, social support and coping", *Annual Review of Psychology*, Vol. 42, pp. 401-25.
- Dewe, P. (1993), "The appraisal process: exploring the role of meaning, importance, control and coping in work stress", *Anxiety, Stress and Coping*, Vol. 5, pp. 95-109.
- Eden, D. (1990), "Acute and chronic job stress, strain and vacation relief", *Organizational Behavior and Human Decision Processes*, Vol. 45, pp. 175-95.
- Evans, B.J. and Coman, G.J. (1993), "General versus specific measures of occupational stress: an Australian police survey", *Stress Medicine*, Vol. 9, pp. 237-46.

-
- Finn, P. (1997), "Reducing stress: an organization-centered approach", *FBI Law Enforcement Bulletin*, Vol. 66 No. 8, pp. 20-6.
- Frankenhaeuser, M. (1991), "The psychophysiology of workload, stress, and health: comparison between the sexes", *Annals of Behavioral Medicine*, Vol. 13, pp. 197-204.
- Graf, F.A. (1986), "The relationship between social support and occupational stress among police officers", *Journal of Police Science and Administration*, Vol. 14, pp. 178-86.
- Haarr, R. and Morash, M. (1999), "Gender, race, and strategies of coping with occupational stress in policing", *Justice Quarterly*, Vol. 16 No. 2, pp. 303-36.
- Hart, P.M. and Wearing, A.J. (1995), "Police stress and well-being: integrating personality, coping and daily work experiences", *Journal of Occupational and Organizational Psychology*, Vol. 68 No. 2, pp. 133-57.
- HeartMath (1999), *Impact of the HeartMath Self-management Skills Program on Physiological and Psychological Stress in Police Officers*, HeartMath Research Center, Boulder Creek, CA.
- Kelsey, R.M., Blascovich, J., Leitten, C.L., Schneider, T.R., Tomaka, J. and Wiens, S. (2000), "Cardiovascular reactivity and adaptation to recurrent psychological stress: the moderating effects of evaluative observation", *Psychophysiology*, Vol. 37, pp. 748-56.
- Kirkcaldy, B. (1993), "Job stress and satisfaction: International police officers", *Psychological Reports*, Vol. 72, p. 386.
- Kirkcaldy, B., Cooper, C.L. and Ruffalo, P. (1995), "Work stress and health in a sample of US police", *Psychological Reports*, Vol. 76, pp. 700-2.
- Klein, G. (1996), "The effect of acute stressors on decision making", in Driskell, J.E. and Salas, E. (Eds), *Stress and Human Performance*, Lawrence Erlbaum, Mahwah, NJ, pp. 49-88.
- Krantz, D.S. and Manuck, S.B. (1984), "Acute psychophysiological reactivity and risk for cardiovascular disease: a review and methodologic critique", *Psychological Bulletin*, Vol. 96, pp. 435-64.
- Kureczka, A.W. (1996), "Critical incident stress in law enforcement", *FBI Law Enforcement Bulletin*, Vol. 65 No. 2/3, pp. 10-16.
- Larson, G., Kempe, C. and Starrin, B. (1988), "Appraisal and coping processes in acute time-limited stressful situations: A study of police officers", *European Journal of Personality*, Vol. 2, pp. 259-76.
- Lazarus, R.S. and Folkman, S. (1984), *Stress, Appraisal and Coping*, Springer, New York, NY.
- Lazarus, R.S. and Folkman, S. (1991), "The concept of coping", in Monat, A. and Lazarus, R.S. (Eds), *Stress and Coping: An Anthology*, 3rd ed., Columbia University, New York, NY, pp. 189-206.
- McCafferty, F.L., Godofredo, D.D. and McCafferty, E.A. (1990), "Post-traumatic stress disorder in the police officer: paradigm of occupational stress", *Southern Medical Journal*, Vol. 83 No. 5, pp. 543-7.
- McCafferty, F.L., McCafferty, E. and McCafferty, M.A. (1992), "Stress and suicide in police officers: paradigm of occupational stress", *Southern Medical Journal*, Vol. 85 No. 3, pp. 233-43.
- McLaren, S., Gollan, W. and Horwell, C. (1998), "Perceived stress as a function of occupation", *Psychological Reports*, Vol. 82, p. 794.
- Martelli, T.A., Walters, L.K. and Martelli, J. (1989), "The police stress survey: reliability and relation to job satisfaction and organizational commitment", *Psychological Reports*, Vol. 64, pp. 267-73.
- Modlin, H.C. (1978), "Does job stress alone cause health problems?", *Occupational Health and Safety*, September/October, pp. 38-9.
- Newton, T.L. and Contrada, R.J. (1994), "Alexithymia and repression: contrasting emotion-focused coping styles", *Psychosomatic Medicine*, Vol. 56, pp. 457-62.
- Nordlicht, S. (1979), "Effects of stress on the police officer and family", *New York State Journal of Medicine*, March, pp. 400-1.

- Peacock, E.J., Wong, P. and Reker, G.T. (1993), "Relations between appraisals and coping schemas: support for the congruence model", *Canadian Journal of Behavioural Science*, Vol. 25, pp. 227-36.
- Peters, M.L., Gadaert, G.L.R., Ballieux, R.E., van Vliet, M., Willemsen, J.J., Sweep, F.C.G.J. and Heijnen, C.J. (1998), "Cardiovascular and endocrine responses to experimental stress: effects of mental effort and controllability", *Psychoneuroendocrinology*, Vol. 23 No. 1, pp. 1-17.
- Powers, S.K. and Howley, E.T. (2001), *Exercise Physiology: Theory and Application to Fitness and Performance*, 4th ed., McGraw-Hill, New York, NY.
- Quaile Hill, K. and Clawson, M. (1988), "The health hazards of 'street level' bureaucracy: mortality among the police", *Journal of Police Science and Management*, Vol. 16 No. 4, pp. 243-7.
- Richmond, R.L., Wodak, A., Kehoe, L. and Heather, N. (1998), "How healthy are the police? A survey of lifestyle factors", *Addiction*, Vol. 93 No. 11, pp. 1729-37.
- Saplosky, R.M. (1992), "Neuroendocrinology of the stress response", in Becker, J.B. *et al.* (Eds), *Behavioural Endocrinology*, Massachusetts Institute of Technology, Boston, MA, pp. 287-324.
- Scheier, M.F., Weintraub, J.K. and Carver, C.S. (1986), "Coping with stress: divergent strategies of optimists and pessimists", *Journal of Personality and Social Psychology*, Vol. 51, pp. 1257-64.
- Selye, H. (1956), *The Stress of Life*, McGraw-Hill, New York, NY.
- Sewell, J.D. (1981), "Police stress", *FBI Law Enforcement Bulletin*, Vol. 50 No. 4, pp. 7-11.
- Simeons, A.T.W. (1961), *Man's Presumptuous Brain: An Evolutionary Interpretation of Psychosomatic Disease*, EP Dutton, New York, NY.
- Spielberger, C.D., Westberry, L.G., Grier, K.S. and Greenfield, G. (1981), *The Police Stress Survey: Sources of Stress in Law Enforcement*, Human Resources Institute, Tampa, FL.
- Storch, J.E. and Panzarella, R. (1996), "Police stress: state-trait anxiety in relation to occupational and personal stressors", *Journal of Criminal Justice*, Vol. 24 No. 2, pp. 99-107.
- Tang, T.L. and Hammontree, M.L. (1992), "The effects of hardiness, police stress, and life stress on police officers' illness and absenteeism", *Public Personnel Management*, Vol. 21 No. 4, pp. 493-511.
- Task Force (1996), "Heart rate variability: standards of measurement, physiological interpretation, and clinical use", *Circulation*, Vol. 93, pp. 1043-65.
- Terry, W.C. (1981), "Police stress: the empirical evidence", *Journal of Police Science and Administration*, Vol. 9 No. 1, pp. 61-74.
- Vena, J., Violanti, J., Marshall, J. and Fiedler, R. (1986), "Mortality of a municipal worker cohort: III. Police officers", *American Journal of Industrial Medicine*, Vol. 10, pp. 383-97.
- Violanti, J.M. and Aron, F. (1995), "Police stressors: variations in perception among police personnel", *Journal of Criminal Justice*, Vol. 23 No. 3, pp. 287-94.
- Violanti, J.M., Vena, J.E. and Marshall, J.R. (1986), "Disease risk and mortality among police officers: new evidence and contributing factors", *Journal of Police Science and Administration*, Vol. 14 No. 1, pp. 17-23.
- Weinberger, D.A., Schwartz, G.E. and Davidson, R.J. (1979), "Low-anxious, high-anxious and repressive coping styles: psychometric patterns and behavioral and physiological responses to stress", *Journal of Abnormal Psychology*, Vol. 88 No. 4, pp. 369-80.
- Westernick, J. (1990), "Stress and coping mechanisms in young police officers", *Australian Police Journal*, Vol. 44, pp. 109-13.