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Original Article

Physiological Demands of Common Occupational Tasks among Australian Police Officers: A Descriptive Analysis

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Abstract

Objectives: The aim of this study was to investigate the physiological demands placed on Australian police officers carrying out common operational tasks.

Methods: Forty participants ($n = 40$) from an Australian police force (mean age = 33.58 ± 7.78 years, mean height = 177.70 ± 7.28 cm, mean weight = 85.68 ± 14.52 kg, mean years of service: 6.74 ± 6.29 years) were recruited through preidentified local area commands. Spanning nine police stations from the same Australian state, volunteers wore monitoring devices to collect physiological measures (heart rate, respiratory rate, and skin temperature) throughout the course of four consecutive shifts (two day shifts and two night shifts). Descriptive data were recorded and analyzed by task and changes in physiological measures.

Results: Of the 345 duty calls attended by participants, the four most commonly reported tasks were as follows: 'check bona fides' ($n = 76$; 22%), 'driving urgently' ($n = 45$; 13%), 'attending a domestic incident' ($n = 37$; 10%), and 'attending a concern for welfare' ($n = 30$; 8%). Mean percentages of maximum heart rates ($\%HR_{max}$) were considered of very light exercise intensity and ranged from 47.11 (± 7.18) to 50.15 (± 9.35) % for checking bona fides through to driving urgently respectively. Fifteen percent of tasks attended had officers exceed 100 $\%HR_{max}$ (near maximal to maximal exercise intensity). Mean skin temperatures varied little (36.02–36.27°C) between tasks, while mean respiratory rates were lowest when attending a domestic incident and highest when driving urgently (22.56 ± 3.83 and 24.72 ± 6.12 breaths/min, respectively).

Conclusion: Police officers experienced numerous physiological challenges ranging from an intensity of very light exercise through to near maximal and maximal exercise throughout their working day with occasions where their heart rates exceeded 100 $\%HR_{max}$. These findings highlight the

What's Important About This Paper?

Police officers experience physiological and psychological stress owing to the nature of their work tasks. This study found that some police officers experienced intense physiological stress during some tasks, leading to heart rates exceeding maximum predicted values. Owing to these demands, cardiovascular monitoring and conditioning is warranted among police officers, a group that experiences high risk of cardiovascular disease and sudden cardiac death.

physiological stress associated with common occupational policing tasks, highlighting the importance of cardiovascular health in police officers and the need for cardiovascular monitoring and conditioning.

Keywords: heart rate; tactical; occupational tasks; duties; cardiovascular disease

Introduction

Police officers are exposed to high physiological and psychological demands on a daily basis. As a result, policing is regarded as being one of the most stressful occupations in our society (Hartley *et al.*, 2007; Gachter *et al.*, 2011). During any given shift, police officers can experience a broad range of emotionally harrowing events, be required to make decisions under duress, and/or encounter life-threatening situations; all of which can dramatically alter an officer's physiological state. Examples of situations that may induce a stress-related physiological response include shootings, robberies, and motor vehicle accidents (Adams *et al.*, 2010). These events are known to cause stress reactions within individuals that elicit a cascade of physiological changes, such as the release of adrenaline and other stress hormones, elevated heart rates, increased rates of perspiration, and increases in muscular tension (Armstrong *et al.*, 2014). Furthermore, these events may result in an elevated physiological response well after the event has ended. For instance, evidence suggests that a police officer's heart rate following a 'real-life scenario drill' remains elevated well-above baseline for more than an hour after the drill (Perroni *et al.*, 2010; Armstrong *et al.*, 2014).

Previous research suggests that law enforcement is primarily a sedentary occupation (Ramey *et al.*, 2014). However, officers may have to respond rapidly to situations that can dramatically increase their physiological requirements. As an example, essential job tasks related to law enforcement have reported average and peak heart rates as high as 80–100% of age-predicted maximum heart rate (Anderson *et al.*, 2001; Dawes *et al.*, 2018). The combination of a sedentary occupation that may result in a decreased fitness levels, short bursts of high intensity activity, and periods of increased physiological strain can lead to increased fatigue, reduced work capacity, and in extreme cases, sudden cardiac death

(Blacker *et al.*, 2009). The latter being of note given findings by Varvarigou *et al.* (2014) identifying sudden cardiac death as contributing to roughly 9–10% of all police fatalities. Furthermore, the nature of police work (e.g. shift work and stress) means police officers are twice as likely to develop cardiovascular disease compared with the general population (Ramey *et al.*, 2014; Orr and Bennett, 2017). Considering this increased risk of cardiovascular disease, the ability to cope with physiologically stressful events throughout the occupational lifespan is of importance in reducing health risks, which could lead to mortalities among police officers (Violanti *et al.*, 2006).

Prior to establishing occupational standards for both mitigating health-related issues and meeting the demands of essential job tasks, it is necessary to profile the physiological demands of essential job tasks while on duty. Determining these physiological demands may provide additional benefits to law enforcement agencies as many fitness assessments within the law enforcement community have come under scrutiny for failing to be representative of the demands required of qualified police officers (Orr *et al.*, 2021b, 2021a). Likewise, determining minimal fitness test scores for hiring and retention is also predicated on determining fitness levels required for the job (Orr *et al.*, 2021b). As such, the aim of this study was to investigate and quantify on duty physiological demands of police officers while performing occupational tasks.

Methods

This study involved 40 participants, of which 82.5% ($n = 33$) were male (mean age = 34.00 ± 7.70 years; mean height = 179.64 ± 6.05 cm; mean body mass = $89.45 \text{ kg} \pm 12.42$ kg) and 17.5% ($n = 7$) were female (mean age = 31.57 ± 8.44 years; mean height = 168.57 ± 5.56 cm; mean body mass = 67.86 ± 9.97 kg).

The mean length of service among all participants was 6.74 (\pm 6.29) years, with participants recruited from a variety of ranks including: Probationary constable (12.5%), constable (40%), senior constable (17.5%), leading senior constable (20%), sergeant (7.5%), and inspector (2.5%). While the officers in this study held different ranks, it should be noted that during the shifts recorded, their primary function was serving as a general duties officer. Thus, for the purpose of this investigation, rank did not affect essential job functions or incident response.

Participating officers were recruited from nine local area commands (LACs) from an Australian state police force. The LACs were selected through purposive sampling as they operated most days of the week with at least two car crews covering first response tasks. Participants were recruited via a two-stage process. First, the commanders of the LACs were asked to identify general duties teams that were able to participate. Following identification of these officers, each officer was contacted by the police researcher (BH) and invited to participate in the study. The purpose of the study was explained, and the officers were informed that participation was voluntary with the option to withdraw from the study at any stage. Ethics approval for the study was provided by Bond University's Human Research Ethics Committee with informed consent gained from all participants prior to participation in the study.

Participants were asked to wear a physiological monitoring belt (Equival, Hidalgo, UK) to collect a range of measures throughout the course of four consecutive shifts, consisting of two day shifts and two night shifts. The physiological monitoring device measured heart rate (HR) in beats per minute (BPM), respiratory rate (RR) in breaths per minute, and skin temperature (ST) in °C.

Prior to the research data collection, all volunteering officers completed a familiarization session (<45 min). The familiarization session involved collecting descriptive information such as age, height, weight, and years of service. In order to identify the Equival harness size, the chest circumference of each participant was measured around the torso at the level of the xiphoid process. The monitoring harness (Equival, Hidalgo, UK) was fitted to the participants and connected to a monitoring device (Equival Eq-02, Hidalgo, UK). HR measures were captured using a HR monitor watch (RS800, Polar Electro from Finland). Real-time HR, RR, and ST were observed using proprietary software (EQ View Pro, Hidalgo, UK), with data read via a direct Bluetooth connection between the EQ-02 module and harness. This process, which occurred as participants walked at a self-selected

speed for 1 km at a 2% incline, was conducted to ensure effective data capture from the devices and comfort of the harness. Throughout this process, the researcher was available to answer any questions regarding the project and was involved with the familiarization and calibration of the equipment with each participant. At the commencement of each shift, all participants were fitted with the monitoring harness, monitoring device, and watch. All devices were collected at the completion of each shift, with data from the Equival EQ-02 monitor downloaded with accompanying software (Equival Manager v2.0, Hidalgo, UK) and saved. The data from the watch were then downloaded to its accompanying software (Polar Protrainer 5, Polar Electro, Finland) for processing. Data from both the Equival EQ-02 system and the Polar RS800CS were imported, synchronized, and merged into VivoSense (v2.7, Vivonoetics, USA) before being exported into the Statistical Package for the Social Sciences (SPSS, Version 22, IBM). HR data were exported at a data rate of five-second intervals. Age-predicted maximum heart rate (APMHR) was determined using the target heart rate equation ($220 - \text{age}$), while the percentage of maximum heart rate ($\%HR_{\text{max}}$) was calculated as a percentage of the APMHR (McArdle *et al.*, 2006).

Immediately following data collection, data from the Computer-Aided Dispatch System (CADS), a police task logging system, were collected and aligned to the physiological data of each participant. The CAD system shows key information about the location each officer attended during their shift, the type of tasks attended, their callsign, as well as the timings and duration of attendance.

Statistical Analysis

Descriptive data were analyzed by tasks and physiological measures (HR, $\%HR_{\text{max}}$, RR, and ST), for all participants, using SPSS (Version 22, IBM). Manual cleaning of the data removed notable cell errors (e.g., non-numeric entries). In addition, data exclusion criteria were applied to remove potentially erroneous data; these exclusion criteria were as follows: HR < 40 BPM or >230 BPM, RR < 8 breaths/min or >50 breaths/min, and an ST < 20 °C or >40 °C. The range, mean, and SD for each variable were then calculated.

Akin to the study by Orr *et al.* (2017) investigating police tasks, the top four most common tasks completed by police officers within the study were identified and subjected to further analysis. A data exclusion criterion was applied to stations, which encountered less than five entries across each of the four most common tasks. This approach was performed to ensure group sizes were as

similar as possible and to avoid smaller group sizes with fewer instances of a given task influencing the data.

Results

Among the 40 participants, 345 police tasks were reported across the four consecutive shifts among the selected stations. These stations were classified as regional ($n = 5$), urban ($n = 2$), metropolitan ($n = 2$), and police stations based on the regions they were located within the state. The dispersion of tasks attended by station region was as follows: Regional stations = 218 tasks, urban stations = 84 tasks, and metropolitan stations = 43 tasks. The top four most commonly reported tasks were as follows: ‘check bona fides’ ($n = 76$; 22%), ‘driving urgently’ ($n = 45$; 13%), ‘attending a domestic incident’ ($n = 37$; 10%), and ‘attending a concern for welfare’ ($n = 30$; 8%). The complete list of 345 tasks attended is detailed in Table 1. The mean durations for the top four tasks ranged from 5.80 (± 5.84) for ‘driving urgently’ (range 0.3–38 min) to 23.15 (± 30.09) min for ‘attending a domestic incident’ (range = 2–134 min).

Table 2 shows the mean, standard deviation, and range for the measured physiological characteristics of the four most commonly reported tasks. After manually cleaning the physiological data, 55 cases (72%) for ‘checking bona fides’, 33 cases (73%) for ‘driving urgently’, 28 cases (76%) for ‘attending a domestic incident’, and 22 cases (72%) for ‘attending a concern for welfare’ were determined suitable for analysis.

Across all four tasks, officers were found to, on occasion, exceed their $\%HR_{max}$. Of the check bona fides tasks, 9% ($n = 5$) of calls had officers exceeded 100 $\%HR_{max}$ (101–112 $\%HR_{max}$). For the drive urgently tasks, 18% ($n = 6$) exceeded 100 $\%HR_{max}$ (103–116 $\%HR_{max}$), while 13% ($n = 3$) exceeded 100 $\%HR_{max}$ (101–111 $\%HR_{max}$) during concern for welfare tasks. During attendance of domestic incidence tasks, 21% ($n = 6$) exceeded 100 $\%HR_{max}$ (103–116 $\%HR_{max}$). Serving as a case example, one male officer was recorded reaching 116 $\%HR_{max}$ (212 beats/min) during attendance of a domestic incident task. The task lasted for 94 min during which the officer’s mean heart rate was 109 beats/min or 60 $\%HR_{max}$.

Discussion

This study investigated the physiological demands experienced among Australian police officers from a state police department across four consecutive shifts. The four most commonly reported tasks in the agencies assessed were checking a person’s bona fides (identity

Table 1. Tasks completed across four consecutive shifts

Task	Number of instances
Check bona fides	76
Driving urgently	45
Domestic violence	37
Concern for welfare	30
Accident	23
Break and enter	20
Arrest	15
Mal damage	10
Noise compliant	7
Steal from motor	6
Neighbor dispute	6
Hoodlums	6
Person on premises	5
Intoxicated person	5
Deceased	4
Stealing	4
Self-harm	4
Driving compliant	4
Shoplifter	4
Brawl	3
Armed robbery	3
Fire	3
Search for object	3
Serve dv notice	2
Abandoned vehicle	2
Stolen vehicle	2
Threat phone call	2
Assault	2
Convey schedule	2
Animal compliant	2
Lockout	1
Property found	1
Missing person	1
Child locked in vehicle	1
Hold up	1
Serve notice	1
Parking compliant	1
Alarm	1
Total	345

and right to be in a specific place, e.g., in a workplace building), driving urgently, attending a concern for welfare, and attending a domestic incident. When the mean $\%HR_{max}$ across the four tasks are considered against the relative exercise intensities proposed by Garber *et al.* (2011), the tasks would generally be considered as very light exercise ($<57 \%HR_{max}$). When the maximum mean ranges for $\%HR_{max}$ are considered, the intensities would be classified as moderate (64–76 $\%HR_{max}$). Furthermore,

Table 2. Physiological measures from the top four tasks

Task	HR bpm (mean range)	HR _{max} % (mean range)	ST °C (mean range)	RR breaths/min (mean range)	Duration minutes (range)
Check bona fides (n = 55)	86.52 ± 12.79 (60.09–125.94)	47.11 ± 7.18 (32.13–68.82)	36.18 ± 0.79 (33.23–37.50)	23.54 ± 5.60 (10.03–39.51)	14.11 ± 11.05 (1.57–46.04)
Driving urgently (n = 33)	91.82 ± 17.62 (65.97–138.44)	50.15 ± 9.35 (36.25–73.25)	36.06 ± 0.92 (33.83–37.21)	24.72 ± 6.12 (12.10–37.84)	5.80 ± 5.84 (0.31–38.12)
Concern for welfare (n = 22)	87.89 ± 10.44 (67.60–109.69)	47.72 ± 6.41 (36.26–61.62)	36.27 ± 0.72 (34.85–37.28)	22.82 ± 2.52 (18.81–27.58)	11.06 ± 10.43 (0.54–44.28)
Domestic incident (n = 28)	92.26 ± 15.97 (66.13–124.49)	49.93 ± 8.79 (35.37–66.31)	36.02 ± 0.98 (33.18–37.32)	22.56 ± 3.83 (16.51–28.56)	23.15 ± 30.09 (2–134)

of the 15% of instances where officers exceeded 100% %HR_{max}, their intensities would be considered as near maximal to maximal (≥ 96 %HR_{max}). As such, attending tasks may be akin to very light exercise, with this intensity potentially increasing to moderate if not near maximal to maximal effort. These findings suggest that although police work may be largely sedentary in nature (Ramey *et al.*, 2014), common job tasks could, in general, be considered as very light exercise.

This research also highlights a potential flaw in reporting police tasks by body position. For example, Anderson *et al.* (2001) reported that officers spent around 373 min of a shift sitting, more than 1.5 times standing and walking combined. However, what the officers were doing while sitting was not described. In this study, when driving urgently to a task, the officer would be in a sitting position, yet they recorded a mean %HR_{max} of 50% (very light exercise); furthermore, 18% of these recorded tasks had officers exceed their 100 %HR_{max} (near maximal to maximal effort). As such, while sitting, in general, may appear to be a sedentary task, in policing it may incur a higher physiological cost ranging from a very light to near maximal to maximal effort exercise intensity level if the officers are driving urgently to a task.

As noted, on numerous occasions throughout a working shift, individual police officers exceeded 100 %HR_{max} with a concomitant increase in RR. An elevated HR and increased RR indicate overexertion and may result in a decrease in functional ability. Previous research suggests that members of professions that are exposed to high levels of stress and overexertion are prone to fatigue resulting in a decrease of cognitive functioning, judgment and accuracy and an increased state of anxiety (Perroni *et al.*, 2010). Consequent failure to perform tasks to a minimum acceptable standard could put the officer, their colleagues and, ultimately, the full complement of personnel involved at risk of harm (Silk and Billing, 2013). These impacts bear consideration given that officers are expected to make sound judgments and perform critical tasks successfully when on duty. One of these critical tasks could be employing their pistol. If, in any of the 15% of instances where officer heart rates were above 100 %HR_{max}, the officer employed their pistol their high heart rates could negatively impact their marksmanship performance (Muirhead *et al.*, 2019).

The occupational nature of police work, including stress exposures, shift work, and poor diet, leave officers at increased risk of cardiovascular disease when compared with the general population (Orr and Bennett, 2017). Given that they must frequently respond to unpredictable and stressful events (Armstrong *et al.*, 2014),

it is not surprising that this study found that the stress reaction within some officers led to heart rate responses of above 100 %HR_{max}. When considered in conjunction with research by Perroni *et al.* (2010) whereby officer HR remained elevated well-above baseline for more than an hour post a scenario drill, and that a sustained elevation of HR is related to a heightened physiological state throughout an officer's working shift (Ramey *et al.*, 2014), the stress on the cardiovascular system already at an increased risk of cardiovascular disease is of concern; notably so given that 9–10% of officer mortalities have been attributed to sudden cardiac death (Varvarigou *et al.*, 2014).

The current study had several limitations. Due to the short duration of the study, this data may not account for potential seasonal variations or the influence of certain entertainment events. In addition, the timeframe of which days the data were collected may alter the findings from weekdays compared with weekends. Future research should focus on monitoring officers for a longer duration of time to account for potential seasonal variations in the types and frequency of duties performed. While duty loads worn by this population are generally around 9–11 kg, individual loads (Schram *et al.*, 2018) were not captured. Furthermore, 45% ($n = 18$) of officers in this study reported wearing load bearing vests, as opposed to duty belts, and these vests may, or may not have, included armor plates. As such, the differences in load distribution and wearing of plates may have impacted on the results (Knapik *et al.*, 2004; Tomes *et al.*, 2017). Finally, an officer's level of cardiorespiratory fitness could potentially affect their individual heart rate response. While this data were not available, future studies should investigate these potential relationships.

Conclusion

Police officers endure numerous physiological challenges throughout a working shift and perform tasks that can range from very light intensity to near maximal or maximal intensity. The potential impacts of these intensities, notably those that are near maximal or maximal, on fatigue and performance (e.g. marksmanship) and on the cardiovascular system, highlight the importance of validated and updated police fitness assessments to ensure they are reflective of the physiological demands of police officers.

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Data Availability

Due to the nature of the research within law enforcement and security constraints, data may only be made available on approval by the law enforcement agency in which this study took place via request through the corresponding author.

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