Profiling the Metabolic Fitness of a Special Operations Police Unit

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Abstract

Objectives: Fitness is essential to specialist police forces, who have higher occupational demands than general police, and vital to performance and mission success. However, little research has been done profiling the metabolic fitness of these units and how they compare to other populations. The objective of this study was to profile the aerobic fitness of a specialist police unit.

Methods: Body weight was measured to account for any impact on metabolic fitness, while VO2 max was estimated via number of shuttles completed on the 20m Progressive Shuttle Run Test (PSRT) (n=47) on two dates one calendar year apart.

Results: There were no significant (p=.116) differences (mean difference 0.40±1.70kg) in body weight between the initial measures (mean=88.84±8.25kg) and the final measure (mean=89.24±8.77kg) 13 months later. PSRT results increased significantly (p<.005) between the initial (mean=72.62±11.76 shuttles) and final assessments (77.51±11.46 shuttles), with a mean increase of 4.89 (± 2.94) shuttles and a small effect size (d=0.42). The mean VO2 max of the specialist police unit was 51.06±3.61 ml/min/kg following the first assessment, and 52.56±3.46 ml/min/kg following the second assessment. This was a significant finding (p<.001), with a mean difference of 1.19±1.27 ml/min/kg and a small effect size (d=0.23).

Conclusions: Elite police forces have a higher metabolic fitness than the general population and general duties police officers. Having and maintaining this fitness level is imperative for their operational success and preventing injuries. This research suggests that despite the challenges

posed by operational requirements, high fitness standards can not only be maintained, but also improved.

Keywords: Law Enforcement, Specialist, SWAT, Tactical

INTRODUCTION

As part of their daily duties, police officers may be subjected to periods of sedentary activity combined with sudden periods of high intensity, physically demanding tasks[1]. These high intensity tasks can include a large variety of activities such as running, jumping, fighting, and crawling, all over varying terrain[1]. Special Weapons and Tactics (SWAT) teams are specialized law enforcement units that respond to situations beyond the duties of the general police force, such as riots, hostage rescues, or terrorist threats[2]. SWAT units require, and hence carry, additional equipment to be able to effectively manage these unique situations[2]. While general duties police perform their occupational tasks carrying external loads of up to 10 kg in weight[3], specialist police personnel can be expected to carry loads of up to 40 kg[4]. These external loads can have a detrimental effect on task performance and lead to injury[3]. Therefore, it is imperative that officers are fit enough to be able to withstand the negative impacts imparted by these heavy loads[2].

Research has shown that both strength and aerobic fitness are correlated with load carriage performance, with aerobic fitness in particular being essential for performance during load carriage tasks in specialist police populations[3]. Aerobic fitness in general has also been shown to be vital for the completion of law enforcement missions[5]. Not only has aerobic fitness been correlated with performance, but research has also shown that high aerobic fitness can reduce injury risk both in law enforcement[6] and other tactical populations[7]. For example, Lisman et al. found that slower three mile run times were associated with higher rates of injury in a military population[7]. Similarly, poor performance in the 20m Progressive Shuttle Run has also been linked to an increased risk of injury in military populations[8, 9].

Aerobic fitness measures have been used as a pre-selection fitness criterion in various specialist tactical populations in attempts to reduce injury risk and promote successful applicant outcomes [10, 11]. This is imperative in the case of specialist police units, as their high external loads lead to increased metabolic demands and energy expenditure[4]. In addition, by establishing the typical specialist police officer's aerobic fitness level, validated standards can be put into place for those attempting to join these elite units[10]. This is important given that specialist police are recruited from general duties police officers, and research suggests that these general duties police officers lose aerobic fitness after initial training and demonstrate decreased aerobic fitness levels compared to cadets[12, 13]. Potential reasons for the loss of aerobic fitness achieved during cadet training include long periods of sedentary duties such as deskwork[13] and occupational requirements such as shift work[14]. While this loss of fitness does occur in a general police force, it remains to be seen if a specialist police force will experience a similar decline, given their higher fitness level requirements and increased operational tempo.

This research has limitations, particularly regarding the homogeneity of the sample group. This study consists of one specialist police force comprised solely of male subjects from Australia. Furthermore, some descriptive characteristics are missing. These limitations may restrict the extrapolation of our findings to other national and international specialist units. Inclusion of other sample groups could grant greater insight into metabolic fitness of specialist police forces. In addition, due to security concerns, examples of the individualized physical conditioning program employed within this population are not available.

Given the importance of aerobic fitness in policing and its impact in many areas including performance[3], injury risk[7], and pre-selection criteria[10], as well as the possible deterioration of this fitness through an officer's career[13], the aims of this study were twofold. The primary aim

was to profile the level of aerobic fitness in a specialist police unit, and the secondary aim was to assess whether this level of aerobic fitness was typical over a sustained period of time. Given the high occupational demands of specialist police forces, we hypothesized that the metabolic fitness of the special police unit would be higher than that of a general police unit, and on par with elite-level athletes. We also hypothesized that this police unit will see an increase in metabolic fitness after a year of training.

MATERIALS AND METHODS

Participants

Retrospective data was collected from 47 Australian male specialist police officers in a non-identifiable format. Due to strict security protocols regarding the identity of these personnel, the only demographic data provided was body weight (mean=88.8±8.25 kg). Restrictions of demographic data for research within policing populations are not uncommon in the literature[15, 16].

Procedures

The retrospective data included body weight and 20m Progressive Shuttle Run Test (PSRT) or 'beep test' results. Both measures were taken at two distinctly separate time points, at the start and end of a calendar year. While the testing occurred a year apart, it fell during the same season, thus testing conditions were comparable. All of the data were collected by the unit's strength and conditioning coach who was well trained in performing these measures. The strength and conditioning coach conducted the measures in accordance with the unit's testing protocols,

which are summarized below. The Bond University Human Research Ethics Committee approved this archival data study.

During the time between testing dates, participants continued with traditional tasks and physical and technical training as part of the unit's daily ongoing processes. This typical training included a formal physical training program. This program, overseen by a Certified Strength and Conditioning Specialist (CSCS) coach, called for each individual to be screened and profiled, to allow the creation of a personalized strength and conditioning program. Ideally each member would follow this program for the entire year. However, due to time constraints and the operational impacts associated with the nature of specialist police work, individuals often had to train in blocks. Due to these limitations it was also difficult for the participants to utilize different macro-cycles and training intensities. However, each individual was provided with one on one coaching as part of the unit's standard and ongoing commitment to maintaining operational fitness.

Prior to the PSRT, body weight was recorded on a Tanita segmental body composition monitor (product number BC-601). Patients were barefoot and wore self-selected training clothing consisting of a t-shirt and shorts. The results were recorded via pen and paper in kilograms to the nearest 100 grams.

The PSRT was conducted on a flat, concrete, non-slip surface with a 20m distance marked out with a 30m Fiber Glass tape measure (Hart Sport) between two identifiable cones. The shuttle intervals were signaled by an audio compact disc from the Australian Sports Commission with each level incrementally increasing in speed. The participants were instructed that the test was an 'individual maximal aerobic power running test,' and that they were required to run towards the

opposite line and reach said line before the next beep, ideally keeping in time with the successive beep. The participants were then required to run back to the starting line before the next beep. This was performed continuously, with each level (consisting of a group of 7 or more beeps) progressively increasing in speed from the initial starting speed of 8.5 km/h. The participants continued running until voluntarily reaching exhaustion. If a participant failed to reach the line before the beep, a failed attempt was marked. If a failed attempt occurred twice in a row, the participant was told to stop, and their level and shuttle number were recorded. However, if a participant were to complete their next level the fail attempts were reset. Results were recorded in levels and shuttles before being converted into the cumulative number of shuttles. The PSRT is a valid measure of establishing aerobic fitness[17], and has previously been used in law enforcement[13] and specialist tactical populations[10] as a measure of metabolic fitness.

Data Reduction and Statistical Analysis

The data was provided in a Microsoft Excel[18] spreadsheet before the 20m PSRT results were converted into VO2 max scores using the equation outlined by Leger et al.[17] (see Figure 1). These results were then imported into the IBM SPSS Statistics[19] software program for further analysis. Following a descriptive analysis, a paired samples t-test was conducted to determine whether any significant differences in body weight, PSRT results, and aerobic capacity existed between the two time points. Alpha levels were set at 0.05 *a priori*.

Effect sizes (*d*) were calculated for the between group comparisons for body weight, PSRT results, and VO2 max by dividing the difference between the means by the pooled SD[20]. The interpretation of the effect size was based on research by Hopkins[21], where values less than 0.2

are considered a trivial effect, 0.2 to 0.6 considered a small effect; 0.6 to 1.2 a moderate effect; 1.2 to 2.0 a large effect; 2.0 to 4.0 a very large effect; and 4.0 and above an extremely large effect.

(Insert Figure 1 here)

RESULTS

There were no significant (p=.116) differences (mean difference = 0.40±1.70kg) in body weight between the initial measures (mean = 88.84±8.25kg) and the final measures (mean = 89.24±8.77kg) 13 months later (Table 1). However, results from the PSRT found a significant (p<.005) increase in the number of shuttles completed between the initial test (mean = 72.62±11.76 shuttles) and the final test (77.51±11.46 shuttles). The mean difference in performance of 4.89±2.94 shuttles yielded a small effect size (d = 0.42). Finally, initial VO2 max results (mean = 51.06±3.61ml/kg/min) increased significantly (mean difference = 1.49±0.92ml/kg/min, p<.005) when compared to final results (mean = 52.56±3.46ml/kg/min) with a small effect size (d = 0.42).

(Insert Table 1 here)

DISCUSSION

The aims of this study were to profile the metabolic fitness of a specialist police unit, and to assess whether this fitness level was typical by re-assessing the officers approximately one year later. The results showed no significant changes body weight, while demonstrating significant

improvements in both PSRT performance and associated VO2 max levels. In contrast to other research concerning the general police force[12], this unit was not only able to maintain their aerobic fitness, but actually significantly increased their VO2 max scores, possibly due to the higher workload performed by specialist units. This may also be due in part to a dedicated Strength and Conditioning program, which may not be present in all general policing populations. Combined with the fact that there was no significant change in body weight, but a significant increase in PSRT performance, it was concluded that the increase in aerobic performance was independent of changes in body weight.

The results show that, as expected, the specialist police forces generally have a higher VO2 max when compared to the general population. Males in the general population ranging in age from 20-29, 30-39, and 40-49 years of age have estimated VO2 max levels of 44.5, 42.8, and 42.2 mL/kg/min respectively[22]. While the age of the tested population cannot be disclosed due to security reasons, the average VO2 max reported here is higher than any reported in the general population. In regards to general police forces, Dawes et al.[13] found VO2 max levels of 44.9, 40.5, and 37.5 ml/min/kg for age groups 20-29, 30-39, and 40-49 respectively; while Rhodes et al. found an average VO2 max of 42.6 ml/kg/min in a general police population[23]. Again, while the age range of the participants in this study cannot be divulged, the average VO2 max is significantly higher than previously reported at any age range, suggesting a higher level of fitness in this specialist police force.

When compared to elite-level athletes, the average VO2 max of this population was slightly lower than that of an average international soccer team, which ranges from 55 to 68

ml/kg/min[24]. However, this unit demonstrated an average VO2 max greater than professional union rugby players, which range from 41.2 to 48.3 ml/kg/min[25]; and similar to American football players, which range from 43.5 to 60.2 ml/kg/min depending on position[26]. Lastly, the VO2 max of elite military special forces has also been reported throughout the literature with numbers ranging from 50.8±6.1ml/kg/min[27] up to 59±6ml/kg/min[28]. The levels achieved by this unit appear to be on par with certain elite military forces, and may even be slightly higher than some elite military units.

Previous research has shown that general police forces tend to lose fitness over the course of their career[12]. Given potential similarities in environment (e.g. shiftwork and stress) that are known to impact on the fitness of law enforcement officers[14], specialist police forces might also be at risk of losing fitness over the course of time. However, this unit was able to maintain their fitness levels over a 13-month period, and actually demonstrated a significant increase in fitness.

The potential benefits of a formal conditioning program within this unit must also be acknowledged. It is important to emphasize that due to the high occupational demands and time constraints experienced by specialist police forces, there may be concern that strength and conditioning programs, whether self-directed or formal, and either conducted on their own time or during work, may not be sufficient to maintain a high standard of fitness. These results show that the typical, ongoing formal physical conditioning program in place for the specialist police was not only enough to maintain the aerobic fitness of the unit, but to actually increase it.

As mentioned earlier, a potential reason for the loss of fitness in general police officers is the sedentary nature of some duties[13]. However, elite police units are often called upon to respond to the most dangerous and physically demanding situations[29]. Furthermore, they undertake their tasks in those situations while carrying loads notably heavier than those of the general police officer, and research shows that heavier loads increase the metabolic demand and energy expenditure of the carrier[4]. This requirement for carrying heavy loads may be an impetus for maintaining, if not increasing, their aerobic fitness. This interpretation is supported by earlier research by Rudzki, which found that soldiers who carry a sufficiently heavy load during training were able to increase their aerobic fitness levels[30].

In conclusion, these results demonstrate that the specialist police force in this study had a higher average VO2 max than the average population, and potentially higher than certain military special forces units. This unit is also had lower, similar, or higher levels of aerobic fitness than elite-level athletes, depending on the sport. This population requires a high amount of fitness to be able work successfully and complete occupational tasks[5]. Given the importance of aerobic fitness not only to performance[3], but also to reducing injury risk[7-9], any loss of fitness, particularly metabolic fitness, in this population could have serious repercussions beyond that seen in the general police force. It is therefore imperative that any athletic trainer, physical therapist, or strength and conditioning coach includes aerobic conditioning as a vital part of their rehabilitation, return-to-duties following injury, or general conditioning programs.

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CONFLICT OF INTEREST: None declared.

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Legends

Figure 1. VO2 conversion equation

Y: VO2 max (ml/kg/min); X: speed (km/h); A: age (years)

Table 1. VO2 max and body weight over the 13 month study period.

Variable	Initial (Mean ± SD)	Final (Mean ± SD)	Difference (Mean ± SD)	*p*-value	Effect size
BW	88.84 ± 8.25 kg	89.24 ± 8.77 kg	-0.40 ± 1.70 kg	$p = .116$	$d = 0.05$
PSRT	72.62 ± 11.76 shuttles	77.51 ± 11.46 shuttles	-4.89 ± 2.94 shuttles	$p < .0005$	$d = 0.42$
VO2 max	51.06 ± 3.61 ml/kg/min	52.56 ± 3.46 ml/kg/min	-1.49 ± 0.92 ml/kg/min	$p < .0005$	$d = 0.42$

SD: Standard Deviation; BW: Body Weight; PSRT: 20m Progressive Shuttle Run Test; VO2 max: Maximal Oxygen Uptake