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Selecting the Best of the Best: Associations between Anthropometric and Fitness Assessment Results and Success in Police Specialist Selection

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ABSTRACT

International Journal of Exercise Science 11(4): 785-796, 2018. To successfully complete specialist police selection, officers must be physically fit. The aim of this study was to investigate the relationship between performance on selected anthropometric and fitness tests and successful selection into a specialist police unit. Thirty-two male police officers (mean age = 29.48±4.99 years) participated in a Barrier Fitness Assessment (BFA), followed by a Specialist Selection Course (SSC). The BFA spanned two consecutive days of testing (pull-ups, push-ups, seven-stage sit-ups, a timed loaded pack march, a Multi-Stage Fitness Test, an agility run, a lift and carry task and a 300m swim assessment). The SSC occurred 4 weeks later and consisted of 8 days of intense police training. Officers who successfully completed the SSC were graded based on their performance and this determined their ultimate selection. Data were categorized into four participant groups: Group 1 - Did not complete the BFA; Group 2 - Completed the BFA but not the SSC; Group 3 - Completed the SSC and were not selected; and Group 4 - Completed the SSC and were selected. A Spearman's rank order correlation analysis was conducted to assess the strengths of the relationships between selection stage achieved and scores on each of the predictor variables, with significance set at 0.05. Height (p=0.011), body weight (p=0.011), pull-ups (p=0.021) and push-ups (p=0.016), seven-stage sit-up scores (p=0.042) and lift and carry speed (p=0.010) were significantly and positively correlated with level of selection success. Results suggest that candidates wishing to attempt selection into specialist police units would benefit from being tall and training to optimize musculoskeletal strength and muscular endurance.

KEY WORDS: Law enforcement, occupational rehabilitation, work-hardening, prevention, tactical, SWAT

INTRODUCTION

Tactical professions, like those of law enforcement, military service and fire and rescue, are physically demanding by nature with their personnel required to perform ever changing tasks, often in unpredictable environments (4). With these tasks requiring a high level of physical fitness when compared to the civilian population (13, 23, 27), it is unsurprising that their injury rates can be higher than that of the public sector (1). This potentially high rate of injuries increases further when tactical professionals undergo training with trainee injuries often

notably higher than those of the general tactical population due to the sudden increase in physical conditioning requirements, the complexity of new physical tasks, reduced opportunity for recovery and resulting increased risk of overtraining (2, 9, 10, 14, 21).

When undergoing training, several studies have identified that a large numbers of trainees suffer from injuries, whether it be during basic training (10, 11, 26, 30), during more advanced training (20) or during specialist selection (8). This injury incidence is problematic for tactical populations internationally (23) making knowledge of factors associated with attrition vital to manage the associated downstream impacts of trainees who fail to complete training, sustain an injury or are medically discharged. Considering this, studies have shown that having a higher level of physical fitness greatly reduces the risk of these trainees sustaining an injury (10, 12, 25) as fitter trainees perform activities at a lower percentage of their maximal capacity and can therefore perform tasks for longer, recover faster and fatigue less rapidly (12). Therefore, in order to minimise the risk of injury during training, preliminary fitness testing is generally accepted as a necessary step in recruitment to ensure tactical personnel are fit enough to train for occupational tasks and to identify those who are at greater risk of injury (7).

Previous research has found that levels of performance in certain physical fitness assessments are associated with injury risk and job performance capability (7, 15, 23). As an example, a study by Pope et al. (23) found that the 20-m Multi-Stage Fitness Test was a good predictor of relative injury risk in trainees undergoing basic military training with trainees who scored in the lower percentiles five times more likely to sustain injury than recruits who scored in the higher percentiles (23). Likewise, a study by Evans et al. (7), also in a military population, found that trainees in the lower quartile on the sit-up test had two times the risk of lower extremity and low back training injuries than trainees who performed well and were 19 times more likely to sustain an injury in the field. In a more specialist population or military special forces, Hunt et al., (8) found that those who performed more poorly in a loaded pack march, push-ups and sit-ups were more likely to fail to pass specialist selection. As such, during the selection and training of general and specialist tactical personnel, these individuals are subjected to high physical duress in order to simulate occupational requirements and to screen individuals who are appropriate for specialist recruitment (7, 8).

In law enforcement, special unit police officers (like Special Weapons and Tactics [SWAT] officers) are more likely to encounter high-risk and dangerous situations when compared to general police officers (31). In addition, these SWAT officers may be required to perform at higher workloads than traditional law enforcement officers, wearing protective body armour and carrying equipment and gear that can weigh around 23 kg (3) and in some cases in excess of 40 kg (24). Often these special unit police officers are required to deal with hazardous situations such as narcotic searches, apprehending armed and dangerous fugitives, hostage situations, riots and other risky tasks (18). During such operations these officers regularly apply the use of force in close combat situations, navigate obstacles and barriers, carry, lift and drag various equipment or civilians to safety or maintain stealth positions for prolonged periods of time, all whilst wearing this heavy equipment (5). As in military populations,

determining which fitness measures are most correlated with survivability in SWAT selection may assist in the identification of necessary physical capabilities that reduce injury risk, attrition and in field fatalities for SWAT candidates attempting selection.

Considering this need, there is currently a lack of evidence regarding the relationships between anthropometric and fitness measures and survivability in paramilitary personnel, such as the police SWAT units. Therefore, the aim of this study was to investigate which physical measures were associated with successful selection into a police force specialist unit.

METHODS

Participants

Thirty-three male participants (mean age = 29.48 ± 4.99 years: mean height = 179.36 ± 5.70 cm: mean weight = 88.00 ± 19.47 kg) volunteered to participate and completed a Barrier Fitness Assessment (BFA) prior to completing a Specialist Selection Course (SSC). However, only those who successfully completed and achieved fitness pass standards on the BFA were eligible to attend the SSC. The participants who self-nominated to attempt specialist selection were all volunteers and varied in years of law enforcement service from 2 – 19 (mean = 5.0 ± 3.71) years. The sample for this study consisted of all the participants (100%) who attended the specialist selection process.

Protocol

Retrospective data were provided for police officers undergoing specialist police unit selection which consisted of an initial BFA, followed by an intensive SSC. The BFA spanned two consecutive days. Day One consisted of a maximal pull-up, push-up, and dip assessments, a timed 10km loaded pack march and abdominal strength and endurance assessments. Day Two consisted of a 20-m Multi-Stage Fitness Test (MSFT), an agility run, a lift and carry task and a 300m swim assessment. The protocols for each task are described below:

Pull-ups: The pull-ups assessment involved completing as many correct repetitions as possible, without rest, in 2 minutes. Using a prone grip on a suspended metal bar, participants started at full hang with feet free of the ground. On the command to commence, they were required to raise themselves up, so their chin was over the top of the bar and then lower back down to the starting position (equalling 1 repetition). All movements needed to be smooth and controlled to be considered a valid repetition. The number at which the last fully completed repetition was performed was considered their result. The required standard was > 10 repetitions.

Push-ups: The push-ups assessment involved completing as many correct repetitions as possible, without rest, in 2 minutes. Participants started prone with their arms fully extended and only hands and feet in contact with the floor. On the command to commence, participants were required to flex at the elbows and lower their bodies until the upper arms were at least parallel to the floor before extending their arms and returning to the start position (equalling 1 repetition). All movement needed to be smooth and controlled to be considered a valid

repetition. The number at which the last fully completed repetition was performed was considered their result. The required standard was > 40 repetitions.

Dips: Participants had one minute to complete as many correct repetitions as possible. Starting with their legs hanging down below their hips and arms fully extended, the participants were required to flex at the elbows and lower their bodies until their upper arms was at least parallel to the floor before extended the arms and returning to the start position (equalling one repetition). Participants could not rest during the test period and all movements needed to be smooth and controlled to be considered a valid repetition. The number at which the last fully completed repetition was performed was considered their result. The required standard was > 16 repetitions.

7-Stage Sit-up: The 7-stage-sit-up test for abdominal muscular strength followed the protocol as described by Dortkamph (6). In general, the assessment required the participant to complete a sit-up movement of increasing difficulty with the final stage being a full sit-up holding a 5 lb plate weight behind the head on the upper shoulders. The last stage at which the participant could complete a single complete repetition correctly was the classified as the participant's result. The minimum required standard was Level 3.

Prone Hold: The prone hold required the participants to maintain a static flat body position, weight bearing on forearms and feet, for as long as possible. The duration for which the participant could maintain the prone hold position was measured in seconds. The pass standard was 120 seconds.

Loaded March: Participants had to complete a distance of 10 km on foot while carrying a 20 kg backpack. The march was performed on a footpath located around local parkland over flat terrain. Participants completed this task in overalls, boots, appointments (e.g. batons, handcuffs, oleoresin capsicum spray), and a M4 replica rifle made from resin. The march had to be completed in under 90 minutes.

Agility Run: The agility run was completed in their physical training uniform and consisted of running over various terrain incorporating a number of activities such as push-ups, sit-ups, and stair climbing. The agility run was required to be completed in under 20 minutes and 30 seconds.

Lift and Carry: The lift and carry assessment required participants to carry an 80 kg dummy up and down stairs. Participants had to run forward 12 m and then up 45 m of stairs (each stair was 130 mm high and 350 mm deep). At the top of the stairs they had to turn around a cone and return down the stairs to the start. The participants then completed a 2nd lap of stairs this time dragging an 80 kg dummy. Following this 2nd lap, participants completed a 3rd lap without the dummy. The course was to be complete in in under 3:20 min.

Tread Water and 300m Swim: The swim proficiency assessment was completed in sheltered waters (marina setting) over an out and back course. Participants were required to tread water

in police issue overalls and running shoes for 3 minutes before commencing the swim component. A freestyle stroke was to be used to complete the swim as fast as possible. The whole assessment was required to be completed in under 19 minutes.

Participant results were recorded immediately after each completed test. The tests were conducted by, and all result data were collected by, qualified police Physical Training Instructors. Those that completed all assessments in the BFA and achieved suitable scores progressed onto the SSC while participants who were unable to complete the BFA to a satisfactory standard, due to inadequate fitness or sustained injury, were exempt from progressing.

The SSC, took place approximately 4 weeks post BFA and consisted of 8 days of high volume intense training with police specific drills designed to be of great vigour and difficulty. Participants were subjected to harsh conditions including nutritional and sleep deficits over the selection period. Participants who sustained an injury during the course reported to police medical personnel for assessment and those who were deemed unfit to continue were removed from the course. The remaining participants who successfully completed the SSC were also graded based on their performance, and this performance determined their ultimate selection. As such, participants could complete the course but may or may not have been selected for service in the specialist unit. Ethics approval this study was provided by the Bond University Human Research Ethics Committee (#15412).

Statistical Analysis

Data collected for each participant were entered into Microsoft Excel 2013 (Microsoft, Redmond, Washington, USA) and then imported into IBM Statistical Package for the Social Sciences (SPSS), Version 23.0, which was used for all analyses. Participants were categorised into four key groups, reflecting each stage of the assessment process, being: Group 1 - Participants who did not successfully complete the BFA; Group 2 - Participants who passed the BFA but did not complete the SSC; Group 3 - Participants who completed the SSC but were not chosen for specialist employment (found unsuitable due to other reasons not related to physical ability); and Group 4 - Participants who completed the SSC and were chosen for specialist employment. Following descriptive analyses, Spearman's rank order correlation analyses were conducted to assess the strengths of the relationships between selection stage achieved and each assessed anthropometric and fitness variable. Frequency distributions were plotted and compared between groups for each independent variable that was significantly associated with level of specialist selection success, to enable visual analysis of the proportions of participants achieving each stage of the selection process who also achieved particular scores on the respective independent variables. This visual analysis enabled the construction of a profile of anthropometric and fitness attributes that characterised participants who reached each stage in the specialist selection process. Where between-group mean differences were apparent, the levels of statistical significance of these differences were assessed using one-way analyses of variance (ANOVA) and post-hoc Bonferroni tests. The level of significance for all analyses was set at 0.05, *a priori*.

RESULTS

Of the 32 participants for whom data were obtained, 7 did not successfully progress past the BFA (Group 1) and another 8 participants were unable to complete the SSC (Group 2) due to injury, illness or inadequate fitness. The remaining 17 participants completed the BFA and SSC (Groups 3 and 4) but only 10 participants were selected for the specialist unit (Group 4) with the remaining 7 participants considered unsuitable for other non-physical reasons (for example weapon safety).

Table 1. Participant anthropometric and fitness characteristics by level of success, and correlation between each characteristic and level of success

GROUPS	Group 1 (failed BFA; n=7)	Group 2 (passed BFA, failed to complete SSC; n=8)	Group 3 (completed SSC but not selected; n=7)	Group 4 (completed SSC and selected; n=10)	Correlation between characteristic & level of success
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	r_s, p
Height (cm)	177.86 ± 6.91	175.75 ± 2.66	177.71 ± 4.72	183.80 ± 4.59	0.441, p=.011*
Weight (kg)	80.29 ± 11.28	82.88 ± 5.99	82.86 ± 9.21	91.40 ± 5.46	0.443, p=.011*
Age (yrs)	29.14 ± 5.61	29.75 ± 3.73	29.14 ± 5.79	29.60 ± 5.82	-0.016, p=.932
Yrs of service (yrs)	4.14 ± 1.95	5.75 ± 3.41	5.43 ± 3.51	4.70 ± 5.03	-0.171, p=.349
Pull-ups (reps)	12.43 ± 4.16	15.75 ± 6.14	14.57 ± 1.90	16.10 ± 3.38	0.406, p=.021*
Push-ups (reps)	46.57 ± 9.73	50.38 ± 9.37	47.57 ± 3.26	58.80 ± 11.89	0.422, p=.016*
Ab Str (Level 1-7)	2.57 ± 0.77	3.00 ± 0.00	3.00 ± 0.00	3.00 ± 0.00	0.362, p=.042*
Prone Hold (secs)	120.00 ± 0.00	120.00 ± 0.00	120.00 ± 0.00	120.00 ± 0.00	All reached max
Dips (reps)	22.57 ± 5.91	24.38 ± 5.45	23.86 ± 4.26	25.30 ± 5.21	0.215, p=.237
March (h:min:s)	#	1:19:23 ± 0:02:56	1:23:10 ± 0:05:00	1:17:40 ± 0:03:51	-0.184, p=.377
MSFT (no. of shuttles)	#	102.88 ± 12.11	101.00 ± 12.71	101.60 ± 6.11	0.051, p=.808
Agility run (secs)	#	18.07 ± 1:11	17.13 ± 1:20	17.12 ± 0.29	-0.303, p=.141
Lift and carry (min: secs)	#	2:54 ± 0:15	2:58 ± 0.08	2:40 ± 0:09	-0.508, p=.010*
300m swim (min: secs)	#	13:14 ± 1:35	15:03 ± 0:29	11:42 ± 2:17	-0.321, p=.118

*Correlation is significant at the 0.05 level. # Participants from Group 1 did not complete these assessments.

Although there was some spread of scores in each group on most participant anthropometric and fitness characteristics, successful applicants (Group 4) tended to be taller (183.80 ± 4.59 cm) and heavier (91.40 ± 5.46 kg) than unsuccessful applicants (Table 2 and Figure 1). The observed differences between the groups in mean heights and weights (Table 1) reached statistical

significance ($F_{3,28}$= 4.74, p=.009 and $F_{3,28}$= 3.30, p=.035, respectively), though in post-hoc Bonferroni tests only the difference in mean height between successful applicants and those who did not complete the selection course reached significance (p=.010). Nevertheless, the Spearman's correlation coefficients and accompanying p-values (Table 1), along with the plots of heights and weights by level of selection success (Figure 1), each taking into account the full data set, indicate significant positive relationships between applicant heights and weights and levels of specialist selection success, such that taller and heavier applicants tended to be more successful. Further Spearman's rank order correlation analyses revealed no significant correlations between participant height or participant weight and any of the participant fitness test scores. Those applicants who were more successful in the specialist selection process also tended to perform better than less successful applicants on fitness tests including pull-ups, push-ups, the 7-stage sit-up test, and the lift and carry (Table 1 and Figure 1), and these relationships reached statistical significance in the Spearman's rank order correlation analyses (Table 1). Conversely, participant age, years of service, 300m swim time, MSFT score, agility run time, dip test score and time to complete the loaded march test were not significantly associated with success in the specialist selection process (Table 1).

DISCUSSION

The aim of this study was to investigate which physical measures were associated with successful selection into a police force specialist unit. Level of success in the selection process was significantly and positively correlated with applicant height and body weight, and with their upper body and trunk relative strength (as measured by pull-ups, push-ups and sit-ups), as well as with their speed of movement in a lift and carry task.

There were few studies against which this research could be compared, with the only two appropriate studies found (8, 29) investigating the associations between fitness measures and selection outcomes in specialist personnel being in military special forces. The first study by Teplitzky (29) found that U.S. soldiers who performed better on their Army Physical Fitness Test Scores (composite scores from a test of sit-ups, push-ups and a 2-mile run) and ruck march with load (no further details were reported due to sensitivity of information) were more likely to successfully complete the Special Forces Assessment and Selection program. In Australian Army Special Forces (both Commando and Special Air Service Regiment), soldiers who performed better than their peers on the 2-minute cadence push-ups (cadence 1:2) during their Special Forces Selection Test and completed the 3.2 km Battle Run wearing webbing of 9 kg and carrying a rifle (minimum standard of 16 minutes) and a 20 km pack march with 28 kg (minimum standard was 3 hours 15 minutes) conducted at the beginning of the Commando Selection and Training Course or the Special Air Service Regiment (SASR) Selection Course, were more likely to successfully complete their relevant (Commando or SASR) selection courses (8). For the Australian Army soldiers, other assessments, which included a MSFT, 5 km loaded pack march with 40 kg, 7-stage sit-up, agility run, sit and reach flexibility test and vertical jump height, were not associated with success. However, it should be noted that all assessments were performed to a relatively high standard. Considering this, when a manual analysis of all measures was done to minimize potential false negative predictions when

setting proposed selection standards, a combination of the 7-stage sit-up (above level 5), push-ups (over 66 repetitions to cadence) and the 5 km loaded pack march (completed under 45:45 mins) was recommended.

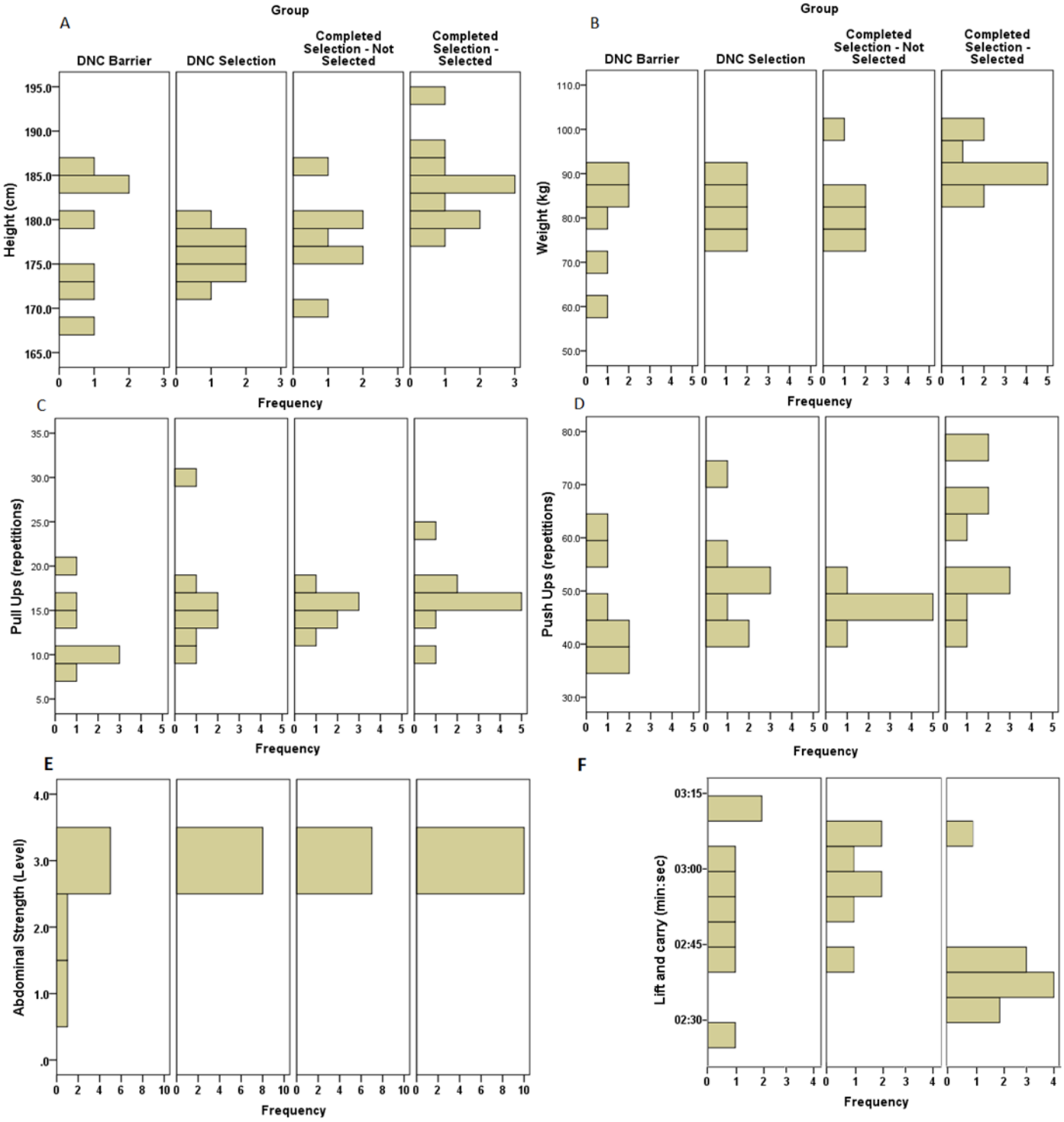

Figure 1. Frequency distributions plotted and compared between groups for each significant predictor of achievement: A) Height, B) Weight, C) Pull-ups, D) Push-ups, E) 7-stage-sit-up, F) Lift and Carry tasks.

The results of this study, akin to the aforementioned selection studies in special forces soldiers identified push-up and sit-up performance to be associated with level of selection success. However, unlike the aforementioned studies, pull-up performance was associated with success in this study, and unlike both of the special forces studies, pack march performance was not significantly associated with selection success in this study of a police population. A potential reason for this key difference between these studies could be the differences in load carriage requirements between these populations, with military personnel carrying heavier loads or moving faster, where either increased load or increased speed increasing the energy costs of completing the task (16).

One finding of interest was the finding that aerobic fitness measures were not significantly associated with selection success in this study, as was observed in the study by Hunt et al. (8). Previous work in tactical trainees has found that new trainees with lower levels of aerobic fitness, as measured by a MSFT (20, 23), 30-15 Intermittent Fitness Test (22) or run for time (14, 28), were more likely to be injured and/or fail to complete training. In both the study by Hunt et al., (8) and in this study, aerobic fitness as measured by the shuttle run was not significantly associated with level of selection success. One potential reason for this finding may be the notably higher levels of fitness in these specialist populations. For example, aerobic capacities (as predicted by the MSFT) observed in the study by Hunt et al., (8) were considered to be in the 'excellent' range against normative population values for the mean age of applicants (successful mean maximal aerobic capacity = 55.1±3.3 $mL.kg^{-1}.min^{-1}$; unsuccessful mean maximal aerobic capacity = 54.2±2.8 $mL.kg^{-1}.min^{-1}$), as were the levels of aerobic fitness observed in this study (mean predicted (19) maximal aerobic capacity = 54.2±2.8 $mL.kg^{-1}.min^{-1}$). On this basis, a law of diminishing returns may exist whereby, any further gains in the very high aerobic fitness of candidates may no longer contribute to mitigating injury risk or successful course completion. Considering this, caution would be advised if candidates were only to train for the types of assessments for which scores were significantly associated with level of selection success, at the expense of their other areas of fitness.

While there is limited research investigating fitness requirements associated with success in police selection into specialist teams, a paper by Koepp (17) provides insights into some physical fitness standards currently forming part of selection requirements for teams in the U.S. Three U.S. SWAT departments were found to require their applicants to be able to complete 50 push-ups (two minutes) and between three to five pull-ups in order to be selected. In this study, participants were required to complete a minimum of 40 push-ups and 10 chin ups as part of the selection process and while the mean scores of all four groups met these standards, the successful applicants completed significantly more push-ups (58.80 ± 11.89 repetitions) and chin ups (16.10 ± 3.38 repetitions). Other requirements listed as part of selection requirements noted in the study by Koepp (17) included a two-mile run in under 16 minutes, or a one-mile run in under 9 minutes, 50 sit-ups in 2-minutes, an obstacle course or a minimum on the Cooper's test of 200 points. It is important to note, that not only were there set physical fitness assessment requirements for almost all of the U.S. SWAT teams investigated Koepp (17) but there were other requirements, ranging from weapon skills to minimum field experience and sick leave reports.

In conclusion, acknowledging the already high levels of aerobic fitness of police candidates applying for specialist selection in this study, measures of relative strength and endurance of the upper body and trunk appear to be of importance for police officers wishing to undergo specialist selection. In addition, an ability to lift and carry loads quickly to complete tasks may be required to optimize their chances of selection success.

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