

Are there similarities in physical fitness characteristics of successful candidates attending law enforcement training regardless of training cohort?

Robert G. Lockie, Michael Stierli, J. Jay Dawes, Karly A. Cesario,
Matthew R. Moreno, Ashley M. Bloodgood, Robin M. Orr, Joseph M. Dulla

Objectives: The aim of this study was to determine if there were differences in physical fitness performance across different cohorts of successful candidates attending law enforcement agency (LEA) training.

Design and Methods: Retrospective, non-identifiable, data from three training cohorts, comprising 226 LEA candidates ($\sigma = 196$; $\varphi = 30$) were analyzed. Data from a standard testing battery used to screen new candidates on entry were used to inform physical fitness performance. This battery included: maximal number of push-up and sit-up repetitions in 60 seconds (s); a 75-yard pursuit run (75PR) around a pre-determined course designed to mimic a foot pursuit; an arm ergometer test where candidates completed as many revolutions in 60 s; and the 2.4 kilometer (km) run. A one-way analysis of variance with Bonferroni post hoc adjustments compared age and test results across the classes. Alpha levels were set at $p < 0.05$ a priori.

Results: There were no significant ($p = 0.091$ - 0.458) differences between the three cohorts for age, maximal number of push-ups and sit-ups completed in 60 s, time to complete the 75PR, number of revolutions completed in the 60 s arm ergometer test, or time to complete the 2.4 km run.

Conclusions: The level of physical fitness for new candidates attending LEA training, as measured by the testing battery, was similar across cohorts attending training and as such physical training programs to prepare new candidates for LEA duties may not need to be different. However, trainers should be aware of individual variations in physical characteristics within classes to optimize individual gains.

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INTRODUCTION

Law enforcement is a physically demanding occupation where, during a shift, officers may need to push, pull, lift, carry, drag, jump, vault, crawl, sprint, use force, and pursue a suspect.^{5, 7} Some of the underlying capacities important for these physically demanding tasks include aerobic capacity, running speed, upper- and lower-body power, and muscular strength and endurance.^{3, 4, 7} Accordingly, most law enforcement agencies (LEA) require candidates to complete physical fitness training on entry in order to prepare them for the physical demands of their profession.^{3, 4} As such, testing batteries that assess qualities needed to safely and efficiently complete the required training and occupational tasks are often performed at the LEA training institution.^{1, 9, 10} Physical tests commonly used across different LEAs as part of these testing barriers often include push-ups and sit-ups to measure muscle endurance, and timed runs over certain distances (e.g. 2.4 kilometer [km], or 1.5 mile, run) to assess aerobic capacity and general fitness.^{2, 4, 7} Certain agencies may include other tests, such as change-of-direction runs, timed arm ergometer tests,¹³

and measures of power such as the vertical jump.¹⁵

Within a battery employed by a LEA, candidates do not necessarily have to perform well in all tests within a battery if a combined score can dictate whether a candidate meets the overall fitness requirements. For example, candidates can compensate with better performance in one test if they do not score as well in another.¹⁶ Due to these circumstances, the physical qualities of candidates who meet the required fitness standards to commence training at a LEA could fluctuate from cohort-to-cohort. For example, fitness measured by the 2.4 km run varied greatly in US Navy recruits in different training divisions prior to the commencement of boot camp.¹⁸

As LEAs draw broadly from the population,²⁰ and given the varied physical demands of law enforcement that the candidates must develop,^{5, 7} law enforcement officers providing physical training to the candidates may need to be aware of potential differences in training cohorts. Although the inherent design of LEA testing batteries should ensure relatively consistency across different cohorts by requiring a set minimum performance standard, no known research has been found to investigate potential differences across a sample of candidate

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From the Department of Kinesiology, California State University, Fullerton, Fullerton, CA, USA (R.G.L., K.A.C., M.R.M., A.M.B.), Sydney Police Centre, Surry Hills, NSW, Australia (M.S.), Tactical Research Unit, Bond University, Robina, Qld, Australia (M.S., R.M.O.), Department of Health Sciences, University of Colorado-Colorado Springs, Colorado Springs, CO, USA (J.J.D.), and Recruit Training Unit, Training Bureau, Los Angeles County Sheriff's Department, Los Angeles, CA, USA (J.M.D.)

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Correspondence to Dr. Robert Lockie, Department of Kinesiology, California State University – Fullerton, 800 N State College Blvd, Fullerton, CA 92831, USA. Email: rlockie@fullerton.edu

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cohorts commencing training at a LEA. Therefore, the aim of this study was to investigate differences in physical fitness performance, as measured by a standardized physical fitness testing battery, across three cohorts commencing training at a LEA.

METHODS

Experimental Approach to the Problem

A retrospective analysis of existing data was performed to investigate different training cohorts of candidates commencing training at a LEA. The candidate pool was stratified into three naturally occurring cohorts, and a one-way analysis of variance (ANOVA) was used to compare data. The dependent variables for this study were: age; height; body mass; number of repetitions in push-up and sit-up tests; 75-Yard pursuit run (75PR) time; number of revolutions in the arm ergometer test; and 2.4 km run time.

Candidates

Data were collected by the training staff of a LEA in the USA during the initial recruitment process, and was released with consent from that organization. The LEA is based in southern California, and is the largest in the USA. Given the size of this agency, this assists with increasing the potential generalizability of any study results given the diversity of the sample. This sample of convenience comprised 226 successful candidates ($\sigma = 196$; $\phi = 30$) to the LEA, which covered three training cohorts from within one calendar year. Data were combined for males and females and all age groups (Cohort 1 $n = 90$, Cohort 2 $n = 67$, Cohort 3 $n = 69$), as all candidates for this LEA must attain similar standards regardless of sex and age. Based on the archival nature of this analysis, the institutional ethics committee approved the use of retrospective non-identifiable data.

Procedures

The LEA staff who collected the data were all trained and proficient in conducting the required assessments.¹¹ The physical fitness tests were performed in the order detailed, according to the procedures provided. The push-up and sit-up tests, 75PR, and arm ergometer test were conducted outdoors on a concrete surface at the LEA's facility. The 2.4 km run was performed with candidates completing 6 laps around a 400 m outdoor running track which was also at the facility. Testing occurred during scheduled recruitment days for the LEA.

Push-up Test

The push-up test assessed upper-body strength endurance, where candidates completed as many push-ups as possible in 60 s.^{2,4,7} Candidates started in the 'up' position, with the body taut and straight, the hands positioned approximately shoulder-width apart, and the fingers pointed forwards. This LEA used a standard water bottle to determine the bottom position of the push-up, which was placed underneath the candidate's chest.¹³ On the start command, a designated staff member began the stopwatch, and candidates lowered themselves until their chests contacted the water bottle, and extended their elbows to

return to the start position. The candidates performed as many push-ups as possible in the 60 second (s) time period. Candidates could rest in the up position with elbows locked, but only full repetitions were recorded.^{4,5,11}

Sit-up Test

The sit-up test assessed abdominal muscular endurance, where candidates completed as many sit-ups as possible in 60 s.^{2,4,7} Candidates laid on their backs on padded mats with their knees flexed to 90°, heels flat on the ground, and arms crossed across the chest and hands positioned on the shoulders. The feet were held to the ground by a staff member. On the start command, candidates raised their shoulders from the ground while keeping their arms crossed, and touched the elbows to the knees.¹³ The candidate then descended back down until the shoulder blades contacted the ground, and they completed as many repetitions as possible in the 60 s time period. Candidates could rest in the up position, and only full repetitions were counted.⁴

75-Yard Pursuit Run (75PR)

The 75PR was designed to simulate a foot pursuit for a law enforcement officer,¹³ and is shown in Figure 1. The candidate in this test completed five linear sprints about a square grid (each side was 12.1 meters [m]), while completing four, 45° direction changes zig-zagging across the grid. Candidates were also required to step over three barriers that were 2.44 m long and 0.15 m high that simulated curbs during three of the five linear sprints. Timing, recorded via stopwatch as is standard practice in LEA testing,^{2,3,7} commenced from the initiation of movement at the start of the sprint, until the candidate crossed the finish line. The final time was recorded in s.

Arm Ergometry

The arm ergometer test was used an assessment of upper-body endurance, and was performed on a standard arm ergometer (Monark 881E, Vansbro, Sweden) positioned on a table, and standard procedures were followed for all candidates.¹³ The candidate knelt on a padded mat in a position so that the crankshaft handle was level with the candidate's shoulder. The test began from a position where the left arm of the candidate was fully extended and parallel to the ground.¹⁹ The candidate completed 10 revolutions of the arm ergometer prior to the test to set the resistance at 50 watts. The counter was set to zero before the test commenced. After the LEA staff member initiated the test, candidates completed as many revolutions as possible in 60 s.

2.4 km Run

The 2.4 km run was used to assess aerobic capacity, and was performed on a 400 m running track. Candidates completed six laps around this track as quickly as possible.¹³ They were instructed to slow their pace if they experienced any pain, shortness of breath, or other abnormal signs.¹¹ The 2.4 km run time was recorded for each candidate on a handheld stopwatch to the nearest 0.10 s.^{3,7,11}

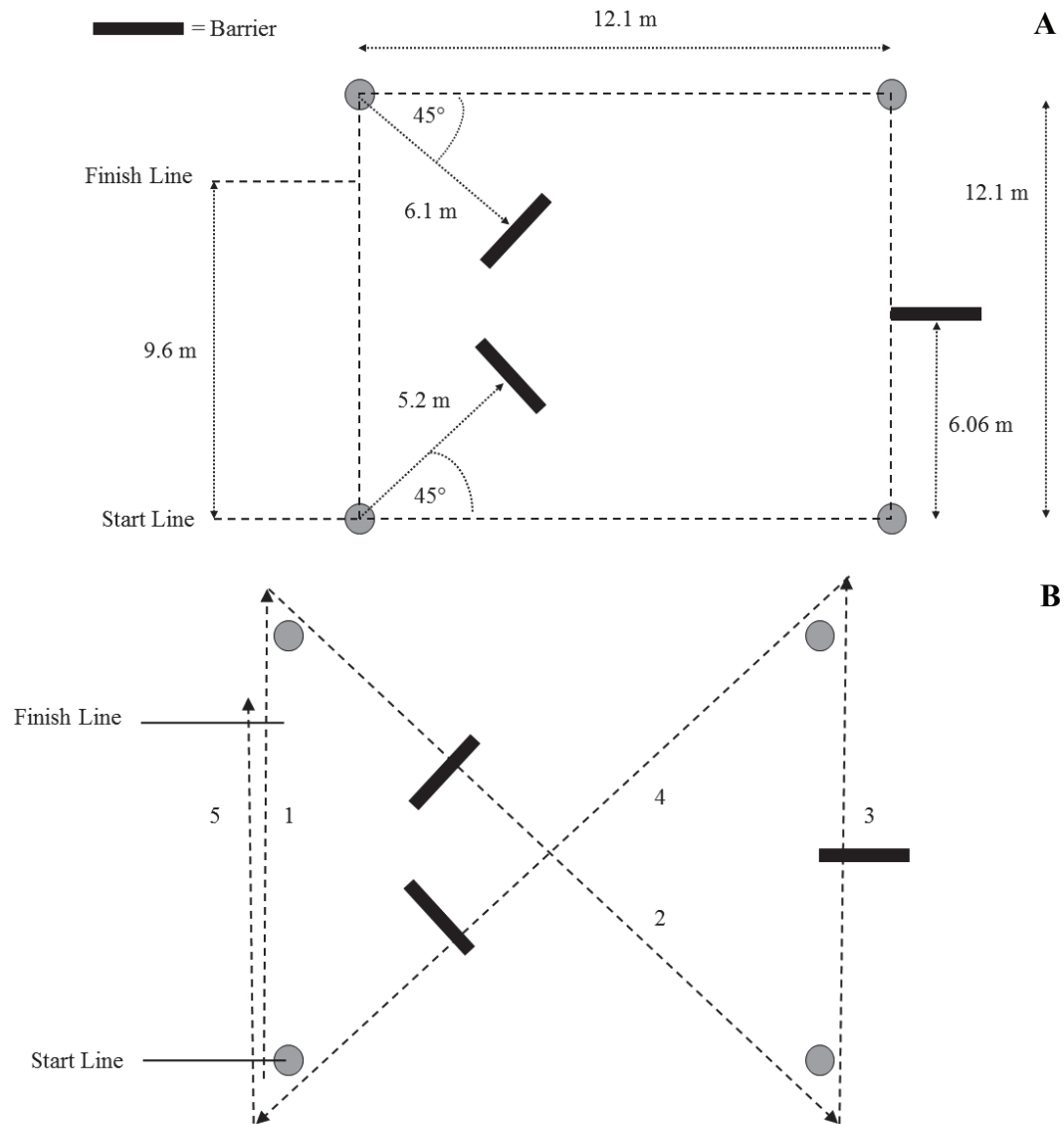


Figure 1 (A) The dimensions for the 75-yard pursuit run in meters (m) and (B) the running direction (numbered in order) for the 75-yard pursuit run. The barriers were 2.44 m long and 0.15 m high.

Statistical Analysis

All statistics were computed using the Statistics Package for Social Sciences Version 24.0 (IBM, Armonk, United States of America). Descriptive statistics (mean \pm standard deviation [SD]; 95% confidence intervals [CI]) profiled each measured parameter. A one-way ANOVA was used to compare the three training classes, with a Bonferroni post hoc for multiple pairwise comparisons with significance set at $p < 0.05$ a priori. One-way ANOVA analyses were conducted due to the size of the sample, and the robustness of this procedure.^{8, 11}

RESULTS

The data for the three training classes and total sample are shown in Table 1. There were no significant differences in age ($p = 0.091$), height ($p = 0.058$), or body mass ($p = 0.056$) between the classes. There were also no significant differences between the classes for the maximal number of push-ups ($p = 0.318$)

and sit-ups ($p = 0.327$) completed in 60 s, the time to complete the 75PR ($p = 0.278$), the number of revolutions completed in the 60 s arm ergometer test ($p = 0.126$), or the time to complete the 2.4 km run ($p = 0.458$).

DISCUSSION

The aim of this study was to investigate differences in physical fitness performance, as measured by a standardized physical fitness testing battery, across three cohorts commencing training at a LEA. The results indicated that there were no significant differences in the characteristics or physical fitness measures across the different cohorts suggesting that regardless of cohort of entry, candidates generally display similar levels of fitness. Considering this, there were notable ranges in performance between groups. For example, the difference in push-up performance between the lowest and highest performers across the cohorts ranged from 10 to 70 (Cohort 1), 16 to

Table 1 Descriptive data (mean \pm SD; 95% CI) for age and physical fitness testing battery performance (number of push-ups and sit-ups completed in 60 seconds, time to complete the 75-yard pursuit run [75PR], number of revolutions completed in a 60 second arm ergometer test, and 2.4 km run time) in three different cohorts of successful candidates for a law enforcement agency in the USA.

	Cohort 1 (n=90)	Cohort 2 (n=67)	Cohort 3 (n=69)	Overall (n=226)
Age (years)	28 \pm 6 (27 – 30)	26 \pm 5 (25 – 27)	27 \pm 7 (26 – 29)	27 \pm 6 (26 – 28)
Height (m)	1.76 \pm 0.09 (1.75 – 1.78)	1.77 \pm 0.08 (1.75 – 1.79)	1.74 \pm 0.10 (1.71 – 1.76)	1.76 \pm 0.09 (1.74 – 1.77)
Body Mass (kg)	82.56 \pm 11.38 (80.19 – 84.92)	79.94 \pm 11.54 (77.03 – 82.85)	78.12 \pm 12.96 (75.18 – 81.07)	80.36 \pm 12.07 (78.80 – 81.93)
No. of Push-ups	40 \pm 13 (37 – 43)	42 \pm 13 (38 – 45)	38 \pm 12 (35 – 41)	40 \pm 13 (38 – 42)
No. of Sit-ups	40 \pm 9 (38 – 42)	40 \pm 9 (38 – 42)	38 \pm 8 (36 – 40)	40 \pm 9 (38 – 41)
75PR (s)	17.41 \pm 1.29 (17.14 – 17.68)	17.27 \pm 1.13 (16.99 – 17.54)	17.60 \pm 1.24 (17.31 – 17.90)	17.43 \pm 1.23 (17.26 – 17.59)
Arm Ergometer No. of Revolutions	130 \pm 1.29 (127 – 134)	130 \pm 17 (125 – 134)	125 \pm 19 (120 – 130)	128 \pm 18 (126 – 131)
2.4 km run time (min:sec)	12:46 \pm 1:56 (12:22 – 13:10)	13:05 \pm 1:46 (12:38 – 13:31)	13:04 \pm 1:41 (12:40 – 13:29)	12:57 \pm 1:49 (12:43 – 13:11)

75 (Cohort 2), and 14 to 76 (Cohort 3). As such, LEA staff responsible for the training of new candidates need to still consider individual variations in physical abilities that could be present within a cohort.

The push-up, sit-up, and arm ergometer tests all provide a measure of muscular strength endurance.^{2,4,7} Depending on the qualities of the candidate, the push-up test could also provide a measure of relative strength.^{11,14} There were no differences between any of the cohorts in these tests, which suggests that collectively, the candidates were relatively similar in upper-body and abdominal strength endurance. However, previous research has shown that incumbent female law enforcement officers, in particular older female officers, may perform less push-ups in 60 s when compared to incumbent male officers.¹¹ Hence, LEA staff responsible for physical training need to consider the potential for variation in these measures across cohorts and training staff from other LEA should consider the limitations of the transferability of these findings.

A major job task for law enforcement officers is the pursuit and apprehension of a suspect.⁷ The 75PR was designed to simulate this physical task under planned conditions.¹³ The results indicated the 75PR performance was similar across the training cohorts. However, change-of-direction performance can vary amongst individuals, due to factors such as lower-body strength,¹⁷ power,⁶ and dynamic stability.¹² As such, while candidates may display similar characteristics across training cohorts, individuals may vary in their ability to sprint, change direction, and exhibit the characteristics necessary to successfully pursue a suspect. LEA training staff will need to consider that, while candidates may have achieved similar results, training to improve performance may require a dedicated focus on different components of the task (i.e. lower

body strength, power, dynamic stability).

The 2.4 km run is a popular test across LEAs to measure aerobic capacity and general fitness.^{3,7,11} As for the other tests, the entry physical testing battery for the LEA resulted in training classes that were not significantly different in the performance of this test. However, it should be noted that sex and age of law enforcement officers can influence aerobic fitness. For example, 2.4 km run time was slower in female incumbent officers when compared to males, and in older incumbent officers when compared to their younger counterparts.¹¹ Given the importance of aerobic fitness for law enforcement officers,^{4,7} trainers should attempt to ensure all members of their classes exhibit appropriate levels of aerobic capacity specific to the job requirements.

CONCLUSION

The results of this study suggest that, while individuals within the cohorts will likely exhibit differences in the specific qualities assessed by the different tests (e.g. upper-body and abdominal strength endurance, running speed, and aerobic capacity), cohorts as a group display similar levels of fitness across the physical testing battery measures. Trainers should be cognizant of individual variations in select physiological capacities that will occur in large training groups, and use this information when programming their training schedules.

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