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Lockie, Robert G.; Orr, Rob Marc; Stierli, Michael; Cesario , Karly A. ; Moreno, Matthew R. ; Bloodgood, Ashley M. ; Dulla, Joe; Dawes, James

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The Physical Characteristics by Sex and Age for Custody Assistants from a Law Enforcement Agency

Brief Running Head: CA Sex and Age Characteristics

Robert G. Lockie[1], Robin M. Orr[2], Michael Stierli[3,4], Karly A. Cesario[1], Matthew R. Moreno[1], Ashley M. Bloodgood[1], Joseph M. Dulla[4], J. Jay Dawes[5].

[1]Department of Kinesiology, California State University, Fullerton, Fullerton, CA, USA.
[2]Tactical Research Unit, Bond University, Robina, Qld, Australia.
[3]Sydney Police Centre, Surry Hills, NSW, Australia.
[4]Recruit Training Unit, Training Bureau, Los Angeles County Sheriff's Department, Los Angeles, CA, USA.
[5]Department of Health Sciences, University of Colorado-Colorado Springs, Colorado Springs, CO, USA.

✉ Robert Lockie
California State University, Fullerton
Department of Kinesiology
800 N State College Blvd
Fullerton, CA 92831
USA
Phone (international): +1 657-278-3316
Email: rlockie@fullerton.edu

ABSTRACT

Custody assistants (CAs) are a position within a law enforcement agency who are responsible for assisting officers with maintaining security in correctional facilities. Unlike other positions, CAs may not be required to complete physical testing prior to being hired. This lack of testing could influence the characteristics of CAs who attend academy training. Therefore, retrospective analysis of performance test data for 108 officers (69 males, 39 females) was conducted. The tests included: grip strength for both hands; number of push-ups and sit-ups in 60 seconds; 201 m (220 yard) and 2.4 km runs; and maximal aerobic capacity ($\dot{V}O_{2max}$) estimated from the 2.4 km run. Data were stratified by sex and age (≤24 years, 25-29 years, 30-34 years, ≥35 years). Independent samples t-tests ($p < 0.05$) calculated differences between males and females. To compare age groups, a one-way ANOVA with Bonferroni post hoc was utilized ($p < 0.05$). Males scored significantly higher than females in hand grip, push-ups, and sit-ups, were faster over the 201 m and 2.4 km runs, and had a higher $\dot{V}O_{2max}$ ($p \leq 0.001$-0.024). There were no significant differences in performance tests across the age groups for either males or females. To better tolerate the rigors of physical training, female CAs should attempt to improve their fitness prior to academy as they often need to complete the same tasks as the males. Age did not appear to influence the physical characteristics of CAs, although all CAs should attempt to develop the fitness qualities needed for their occupation.

Key words: civilian jailer; correctional officer; gender differences; push-ups; sit-ups; tactical

INTRODUCTION

Law enforcement agencies (LEAs) provide a range of job opportunities for people from the general population. Although peace or law enforcement officer (LEO) positions are the most recognized, another important position within a LEA is that of the civilian jailor or custody assistant (CA). A CA tends to be an entry-level position for a LEA, but one that has several important responsibilities. People in these positions are responsible for assisting LEOs with maintaining order and security in custody detention, station jails, or court lockup facilities. This could encompass the searching of cells, responding to alarms to assist colleagues, physical confrontations which could involve control and restraint of an inmate, or the need to pursue and corral an inmate attempting to evade capture (18, 20).

Although a CA is a non-warranted position within a LEA, the requirements for these personnel are similar to that for correctional officers, and there has been some analysis of the physical qualities of correctional officers (18-20). Jamnik et al. (20) stated that strength endurance was an important characteristic when involved in physical conflict with an inmate, or separating inmates who may be fighting. Strength endurance assessments (e.g. push-ups and sit-ups) often feature in physical testing batteries for LEAs (10, 11, 25), so it would be of value to describe these qualities in CAs as there is currently no research that has detailed the strength endurance characteristics of this population. Grip strength was also noted as an important physical quality for correctional officers, as it contributes to the ability to support the individual's body mass during cell searches, in addition to restraining uncooperative inmates (20). Male correctional officers have been found to generate a maximal grip force of approximately 58 kilograms (kg), while for female correctional officers it was approximately 37 kg; no such information currently exists for CAs. Aerobic fitness is an important physiological

characteristic for individuals employed to maintain order and supervise a detention facility (18). Jamnik et al. (20) noted that certain tasks performed in isolation may not fully stress the aerobic system, but when those tasks are performed repetitively they can impose a significant aerobic demand. An example of a situation where this could occur is if a CA must respond to an emergency call by running through a hall or up or down stairs, engage and subdue an inmate, before escorting the inmate to segregation. Accordingly, it would be very useful to detail the aerobic fitness of CAs as measured by a typical test common to tactical populations, such as 1.5 mile or 2.4 kilometer (km) run (3, 10, 11, 25).

In order to ensure their incoming recruits have the requisite fitness to successfully complete the occupational tasks demanded of them, physical training (PT) is generally utilized by LEAs during the academy period (38). Indeed, an employer has a duty of care to their recruits and must ensure they have physical and physiological characteristics to avoid foreseeable risks in their profession (20). The CA position is notable in that depending on the LEA, there may be no mandatory physical ability testing within the job application process (26). Lower entry requirements as it pertains to physical fitness for a position within a LEA could result in a more diverse pool of applicants and recruits (1). A potential issue with this is that in tactical populations (e.g. law enforcement, firefighters, military), applicants that do not demonstrate higher levels of physical fitness may encounter difficulties in successfully completing an intense block of PT during the academy period (34, 38, 42), which will increase their chance of separation (i.e. failing to complete all the tasks demanded of them during academy). Losing recruits during the academy process can lead to greater financial costs for LEAs, including expenses associated with attracting replacement candidates, any medical and health care costs associated with an injury, uniforms, equipment, wages, and various administrative costs (36).

Furthermore, physical limitations could have a negative impact on job performance in tactical populations (44), even if a recruit successfully graduates from the academy. In order to understand the physical fitness characteristics that could influence academy and occupational performance, they must first be described. As stated, there is currently no research that has detailed the physical characteristics of CA recruits prior to the start of academy training.

To better understand the specific law enforcement population of CAs, such that there can be further analysis of academy training and occupation-specific tasks, it is essential that this population is detailed and described. This firstly provides a normative profile of a specific occupation within a LEA. Dawes et al. (11) noted that establishing population-specific normative values will allow for comparisons across both general and LEA-specific occupations that could verify population-related differences in fitness. This information could also be compared to current data on correctional officers and LEOs to determine the potential extent that lower physical ability entry standards may have on the qualities of CA-specific recruits (1). Further to this, Dawes et al. (11) stated that through establishing normative values, greater insight for developing training programs to improve or maintain fitness over the course of a CAs' career can be gained. This is especially pertinent considering the time constraints placed on academy training for law enforcement populations (38), and the challenges to maintain fitness over the course of a career (35).

Therefore, this study investigated the physical characteristics by sex and age of CAs in performance assessments conducted at the start of academy training. This was done via a cross-sectional and retrospective analysis of existing data recorded by the CA training officers from the LEA. The assessments involved measuring a wide range of physiological characteristics and included: hand grip strength of the left and right hands as measured by a hand grip dynamometer;

maximal number of push-up and sit-up repetitions in 60 seconds (sec) to measure muscle endurance; the 220 yard, or 201 meter (m), run to ascertain anaerobic capacity; the 2.4 km run to measure aerobic capacity and general fitness; and maximal aerobic capacity ($\dot{V}O_{2max}$) estimated from the 2.4 km run. Data were initially stratified by sex, before the male and female data were stratified into different age groups. It was hypothesized that male and younger candidates would perform better than the females and older candidates, respectively.

METHODS

Experimental Approach to the Problem

A retrospective analysis of existing data were conducted to investigate the physical characteristics of CAs by sex and age, which is an approach that has been used in previous law enforcement research (11, 25). As stated, the sample was stratified into male and female groups, in addition to different age groups for the males and females. The age groups were: ≤24 years; 24-29 years; 30-34 years; and ≥35 years. The dependent variables for this study were: age; body mass; grip strength for the left and right hands measured in kg; number of repetitions in the push-up and sit-up tests in 60 sec; 201 m run time measured in sec; 2.4 km run time measured in minutes:seconds (min:sec); and estimated $\dot{V}O_{2max}$ measured in milliliters of oxygen consumed per kg body mass per min ($ml \cdot kg^{-1} \cdot min^{-1}$).

Subjects

Data were collected by the CA training staff of one LEA in the USA and were released with consent from that organization for the purpose of conducting this retrospective study. A sample of convenience comprised of 108 CAs (age: 27.91 ± 6.87 years; body mass: 75.59 ± 15.73 kg),

which encompassed three academy classes from the one agency, was utilized. The sample included 69 males (age: 27.54 ± 6.74 years; body mass: 81.27 ± 15.22 kg) and 39 females (age: 28.56 ± 7.13 years; body mass: 65.68 ± 11.11 kg). Similar to previous research on tactical populations (9, 10, 25), only age and body mass data were available for the description of the subjects. Based on the archival nature of this analysis (8-11, 25, 35), the institutional ethics committee approved the use of pre-existing data. The study conformed to the recommendations of the Declaration of Helsinki.

Procedures

The data utilized in this study were collected by the CA training staff of one LEA using the procedures that are detailed. The staff were all trained by the LEA in question, and Tactical Strength and Conditioning Facilitator (TSAC-F) certified instructors verified the proficiency of the staff. All testing was conducted in the first week of academy training for each CA class during scheduled PT sessions. This typically occurred between the times of 0600-0700. Grip strength, the push-up test and the sit-up tests were conducted outdoors at the start of one PT session at the LEA's training facility. The 201 m and 2.4 km run were performed on an athletics track at the LEA's facility.

Grip Strength

Grip strength was measured for the left and right hands, and was adapted from procedures established in law enforcement research (6, 11, 22). Similar to Dawes et al. (11), the hand grip dynamometer (Takei Scientific Instruments, Japan) was adjusted so that the base of the first metacarpal and the middle four fingers were in contact with the handle.

The CAs were instructed to keep their testing arm by their side throughout the assessment (6), and squeezed the handle as hard as possible for approximately 2 sec (32). One attempt was allowed for each hand (11), the left hand was tested first for all CAs, and the score was recorded to the nearest kg.

Push-up Test

Upper-body strength endurance was assessed via a timed maximal effort push-up test (7, 9) where CAs completed as many push-ups as possible in 60 sec. The protocol for this assessment followed that of established research, and was the same for both males and females (3, 7, 9, 10, 25). As described by Lockie et al. (25), the CAs started in the 'up' position, with the body taut and straight, the hands positioned shoulder-width apart, and the fingers pointed forwards. A partner placed a fist on the floor directly under the CA's chest (3, 8-11, 25, 35). Although there are some limitations with this approach, this ensure that the CAs descended to an appropriate push-up depth (3, 8-11, 25, 35). On the start command, the tester began the stopwatch and the CA flexed their elbows, lowering themselves until their chests contacted their partners' fists before extending their elbows until returning to the start position. The CAs performed as many push-ups as possible using this technique in the allotted 60 sec time period. CAs could rest in the up position with elbows locked, but only full repetitions were recorded (7, 25).

Sit-up Test

Strength endurance of the abdominal muscles was assessed via the sit-up test where the CAs completed as many repetitions as possible in 60 sec (3, 7, 10, 25). As detailed by Lockie et al. (25), the CAs laid on their backs with their knees flexed to 90°, heels flat on the ground, and

hands interlocked behind their heads. The feet were held to the ground by a partner during the test. On the start command, CAs raised their shoulders from the ground while keeping their hands interlocked behind their heads and touched their elbows to their knees. The CA then descended back down until their shoulder blades contacted the ground, and completed as many repetitions as possible in the allocated time period. CAs could rest in the down position, but only full repetitions were counted (7, 25).

201 m (220 yard) run

The 201 m run has been used previously in physical assessment batteries of firefighters (5), and was adopted by the CA training officers in this study. A running test over this distance provided a measure of anaerobic capacity (43). The 201 m distance was marked on the athletics track, and the CAs were instructed to run the distance as quickly as possible. The CAs completed the runs in their platoons, which were groups of between 8-12 recruits. Time for each CA was recorded to the nearest 0.10 sec by a handheld stopwatch. Timing via stopwatches is common practice in law enforcement testing (3, 10, 11, 25). Furthermore, test administrators trained in the use of stopwatch timing procedures, which the CA training officers were in this study, can record reliable and consistent data (16).

2.4 km (1.5 mile) Run

The 2.4 km run was used to assess aerobic capacity, and performed on an athletics track. The CAs completed six laps around the 400 m track and were instructed to run this distance as quickly as possible. However, if CAs experienced pain, shortness of breath, or any other abnormal signs, they were instructed to slow their pace (25).

The 2.4 km run time was recorded for each CA on a handheld stopwatch to the nearest 0.10 sec (3, 10, 11, 25). $\dot{V}O_{2max}$ was estimated for male and female CAs via the following equations developed by George et al. (15):

Male $\dot{V}O_{2max}$ *(ml·kg^{-1}·min^{-1}) = 91.736 – (0.1656 x body mass) – (2.767 x 2.4 km run time in min).*

Female $\dot{V}O_{2max}$ *(ml·kg^{-1}·min^{-1}) = 88.020 – (0.1656 x body mass) – (2.767 x 2.4 km run time in min).*

Statistical Analysis

Statistical analyses were processed using the Statistics Package for Social Sciences (Version 24; IBM Corporation, New York, USA). Descriptive data (mean ± standard deviation [SD]; 95% confidence intervals [CI]) were calculated for each variable. Firstly, any differences between males and females were investigated by independent samples t-tests, with significance set at $p < 0.05$. Levene's test for equality of variances were checked to determine whether equal variances were to be assumed or not assumed. Secondly, the data were stratified by age group (≤24 years, 24-29 years, 30-34 years, and ≥35 years) for the males and females separately. A one-way analysis of variance (ANOVA), with Bonferroni post hoc for multiple pairwise comparisons, was used to calculate any differences between the age groups for the male and female data. This type of analysis was conducted due to the size of the sample, and the robustness of the one-way ANOVA (14, 25). Statistical significance was again set at $p < 0.05$. Effect sizes (*d*) were also calculated for the between-group comparisons for sex and age, where the difference between the means was divided by the pooled SD (4). In accordance with Hopkins (17), a *d* less than 0.2 was considered a trivial effect; 0.2 to 0.6 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.

RESULTS

Table 1 displays the comparisons between the male and female CAs. Equal variances were assumed for all variables except for grip strength for both hands. The males were significantly heavier, and were stronger as measured by grip strength for the left and right hands when compared to females. Males also completed significantly more push-ups and sit-ups in 60 sec, were faster over both the 201 m and 2.4 km runs, and had a higher $\dot{V}O_{2max}$ than the females in this study. The effect size for the difference between the sit-up repetitions was small; for body mass, 201 m and 2.4 km run times, and $\dot{V}O_{2max}$ the effect sizes were moderate; and for the two grip strength measurements and number of push-ups, the effect sizes were large.

INSERT TABLE 1 ABOUT HERE

The male age group data, and the associated pairwise effect sizes, are shown in Tables 2 and 3, respectively. There were no significant differences across the age groups for body mass (p = 0.322), or any of the performance tests (p = 0.106-0.942). The 30-34 year group had large effect sizes for their lower left-hand grip strength when compared to the other groups, and large-to-very large effect sizes for right-hand grip strength. There were moderate effect sizes for the slower 2.4 km run time and lower $\dot{V}O_{2max}$ for the 35+ year group when compared to the ≤24 year and 30-34 year groups.

INSERT TABLE 2 ABOUT HERE

INSERT TABLE 3 ABOUT HERE

The female age group pairwise effect size data are shown in Tables 4 and 5, respectively. Similar to the males, there were no significant between-group differences for body mass (p = 0.484) or the performance tests (p = 0.595-0.937). There was a moderate effect size for the difference in body mass between the ≤24 year and 30-34 year groups. The 30-34 year group also had moderate (25-29 and 35+ years) and very large (20-24 years) effect sizes for greater left-hand grip strength when compared to the other groups, and moderate effect sizes for greater right-hand grip strength when compared to the 20-24 and 35+ year groups.

INSERT TABLE 4 ABOUT HERE

INSERT TABLE 5 ABOUT HERE

DISCUSSION

This is the first study to detail the physical characteristics of a sample of CAs from a LEA. This is important information for TSAC-F and training instructors for LEAs, as physical ability testing may not be mandated in this position (26), which could result in classes of a range of physical abilities within a CA class. Greater understanding of CA recruits is thus essential, given that academy training can often adopt a 'one-size-fits-all' approach due to factors such as time constraints and high numbers of recruits (38), and any loss of recruits due to poor physical fitness or injury during PT can be costly to a LEA (36). Furthermore, population-specific normative data is required to inform comparisons across different LEA positions such as the CAs, and to allow for appropriate PT programming (11). The results indicated that the male CAs performed better than the female CAs in tests of strength (hand grip), strength endurance (push-ups and sit-ups), and anaerobic (201 m run) and aerobic (2.4 km run and estimated $\dot{V}O_{2max}$)

fitness. However, there were no significant differences between the age groups when considering either the males or females. What may have contributed to these results is that the age of the CA sample in this study was skewed towards the younger age groups (i.e. less than 29 years of age). This is not surprising, as a CA is often viewed as an entry-level position for a LEA. The results from this study have important implications for the PT programming for CAs, such as considering ability-based training due to sex-related differences in physical performance (38), and physical preparation for job-related tasks (i.e. ensuring changes in physical fitness can positively influence activities completed during a work shift).

In general, males tend to have greater muscle mass than females (21), with greater muscle mass a primary factor in sex-related differences in strength (13, 30). Similar to previous research on LEOs (11, 25) and correctional officers (18-20), the results demonstrated that the male CAs performed better in the strength, strength endurance and running tests when compared to the female CAs. Sex-related differences in muscle mass (13, 21, 30) may have contributed to the differences in the hand grip measurements, and the number of push-ups and sit-ups completed, by the male and female CAs. Anaerobic power is also influenced by muscle mass and strength, in addition to neuromuscular function (29), and these would have influenced the sex differences in the 201 m run time. Males also tend to display greater aerobic power and work efficiency when compared to females (40), both of which would have affected the differences in 2.4 km run times for the male and female CAs. Interestingly, there were relatively more females in this sample of CAs (36%) than other research in LEOs. For example, in the sample of 383 LEOs analyzed by Lockie et al. (25), and 631 state highway patrol officers investigated by Dawes et al. (11), only 5% were female. Given that there was no physical testing requirement to be hired as a CA for this LEA (26), this could have led to more females applying for this position.

Nonetheless, many LEAs will still conduct PT with the expectation that every recruit should be able to complete the same amount of work (38). Even though the PT requirements for a CA may be less than that for a LEO, female CAs should attempt to develop their physical fitness prior to the start of academy training. This should increase their chances of successful graduation (i.e. passing any LEA-specific PT requirements and state-mandated tests), as lower levels of fitness are associated with an increased risk of illness and injury during initial training, as well as training failure in tactical populations (23, 34, 42).

There were no age-related difference in grip strength for either hand from the male or female data. However, the 30-34 year group for males tended to have lower grip strength values when compared to the other groups, while the 30-34 year female group demonstrated greater grip strength. Nonetheless, when compared to other populations, the CAs in this study collectively demonstrated greater hand grip strength when compared to healthy college students (males: dominant hand = 39.5 ± 6.7 kg, non-dominant hand = 39.5 ± 10.3 kg; females: dominant hand = 20.4 ± 5.4 kg, non-dominant hand = 16.8 ± 5.6 kg) (32). The CAs were also similar to men (~45-47 kg) and women (~28-31 kg) from the general population aged from 20-39 years of age (28). However, when compared to other tactical populations, the CAs had lower grip strength values when compared to male LEOs from Turkey (~46-49 kg) (22), male and female LEOs from the USA (~49-52 kg) (6), male (55.04 ± 7.77 kg) and female (37.88 ± 5.34 kg) state highway patrol officers from the USA (11), and male (left = 56.4 ± 8.2 kg; right = 60.0 ± 6.8 kg) and female (left = 36.4 ± 5.9 kg; right = 38.6 ± 5.9 kg) correctional officers (20).

In LEOs, grip strength has been related to shooting performance and marksmanship (6, 22) as well as defensive tactics tasks (37). Although CAs do not receive the firearm training that LEOs receive, higher grip strength will have value for CAs in other situations. Grip strength has

also been related to grappling and wrestling in athletic populations (24), as well as associated defensive tactics employed by LEO (37). With the grip strength of correctional officers linked to inmate restraint, in addition to support of the body mass during cell searches (18, 20), grip strength may form part of an essential requirement for CAs who may be required to restrain a detainee or inmate during their shift if they do not comply with authorized requests from the correctional staff. Interestingly, in an analysis of the occupation-specific tasks of correctional officers, Jamnik et al. (20) found that females used only 85% of their maximal grip strength during inmate restraint (~32-33 kg). Even though this was less than the maximum grip strength for the correctional officers examined by Jamnik et al. (20), these values were similar to maximum values for the CAs in this study (~32-34 kg). Considering the findings of Jamnik et al. (20) within the context of this research, although maximal grip strength is potentially important for CAs, they may not always exert maximal force during occupation-specific tasks. Nonetheless, the PT instructors for CAs should ensure that their recruits develop the requisite grip strength needed to complete the tasks required of them in their job. Particularly for female CAs, they should ensure their grip strength allows them to efficiently and effectively complete job-specific tasks such as inmate restraint (20).

The maximal number of push-ups completed in 60 sec by provides a measure of endurance for the upper-body muscles in LEOs (3, 7, 9, 10, 25). Push-up tests also provide an indication of an individual's relative strength and ability to move their body mass (31). Supporting previous research regarding age-related performance in male LEOs (9), there were no age-related differences in the maximal number of push-ups completed in 60 sec for the males or females. The male CAs in this study completed a similar number of push-ups to males aged from 19-36 years from the USA general population (37.00 ± 11.16) (12), and state highway patrol

officers investigated by Dawes et al. (9) (38.99 ± 7.51 repetitions) and Dawes et al. (11) (39.09 ± 15.61 repetitions). However, they were lower than the incumbent LEOs assessed by Lockie et al. (25) (~40-44 repetitions). The female CAs in this study performed less push-ups in 60 sec than female state highway patrol officers (24.24 ± 11.63 repetitions) (11), and LEOs aged from 20-29 years (31.25 ± 7.85 repetitions) (25). Jamnik et al. (20) noted that upper-body strength and endurance was important for correctional officers as they may be required to hold, push, wrestle, or carry inmates. Even though CAs may not need to complete physical testing prior to being hired (26), they should still attempt to develop their upper-body strength and endurance prior to academy training as push-up ability has likewise been associated with risk of injury in LEO trainees (39). These qualities will contribute to occupation-specific tasks (20), and could possibly be a determining factor in maintaining their safety and well-being during altercations with inmates.

There were no age-related differences in the number of sit-ups completed in 60 sec for male or female CAs. The male and female CAs in this study collectively performed more sit-ups than state highway patrol officers (males = 34.46 ± 10.29 repetitions; females = 31.06 ± 9.52 repetitions) (11), and were similar to LEOs (25) and police academy cadets (3). When compared to general population data analyzed by Esco et al. (12), the male CAs performed less sit-ups when compared to mean data from men aged 19-36 years (41.54 ± 7.88 repetitions), while the female CAs outperformed women aged 18-48 years (28.32 ± 11.62 repetitions). Abdominal strength and endurance are also physical qualities that will contribute to the ability to restrain and move uncooperative inmates. In addition to this, abdominal strength may assist in the alleviation of low back pain (33). Low back pain is a common issue for many individuals involved in law enforcement, due to the load carriage requirements of the occupation (e.g. duty belts and body

armor) (27), as well as extended periods of sitting (2). Particularly for CAs, due to the supervisory requirements of this position, there may be extended periods of sitting during a work shift. Improvements in abdominal strength for CAs should positively contribute to occupation-specific tasks such as inmate restraint, in addition to reducing the risk of low back injury which can results from jobs that involve sedentary periods. This could be a focus for CA recruits prior to academy training, and for PT instructors during the academy.

The 201 m run can provide a measure of sprinting ability and anaerobic power (43). Elite level male and female sprinters will complete a maximal run over 200 m, which is albeit slightly less than 201 m (i.e. 220 yards), in approximately 20-22 sec (41). The mean 201 m times for the male CAs ranged from approximately 32-36 sec, while mean times for the females ranged from approximately 40-43 sec, with no age-related differences for either sex. Correctional officers may have to sustain efforts for periods of 30 sec or longer if they need to protect themselves from an assault by an inmate, or if they need to intervene when inmates are fighting (20). Depending on where a correctional officer is positioned within a facility, they may also have to cover an approximate 200 m distance if they have to respond to an emergency (20). This highlights the need for CAs to have some level of anaerobic power. Incoming CAs should attempt to improve this quality prior to initiating their occupation-specific training in the academy, while CA training instructors should ensure the further development of anaerobic power and high-intensity running performance during the academy period.

The 2.4 km run is commonly used to assess aerobic capacity and general fitness in LEOs (3, 10, 25) and is important for correctional officers during periods where they may need to sustain efforts (e.g. responding to an emergency call, before restraining and moving an uncooperative inmate) (20).

The CAs in this study had 2.4 km run times similar to incumbent LEOs aged 20-29 years (25), but were slower than police academy cadets (3). Cocke et al. (3) stated that police cadets had 2.4 km run times of approximately 12-13 min prior to academy training, which were reduced to approximately 11 min after training. Accordingly, the CAs in this study should have the capacity to greatly improve their 2.4 km run time, which should be reflective of enhanced aerobic fitness. Indeed, when considering the estimated $\dot{V}O_{2max}$ scores for the CAs in this study, the males were generally lower than normative data established for men from the USA aged 20-29 years (44.5 ± 0.4 ml·kg^{-1}·min^{-1}), 30-39 years (42.8 ± 0.5 ml·kg^{-1}·min^{-1}), and 40-49 years (42.2 ± 0.6 ml·kg^{-1}·min^{-1}) (45). Further, the 35+ year male CAs investigated in this study demonstrated moderate effect sizes for their lesser 2.4 km run time and estimated $\dot{V}O_{2max}$ when compared to the 20-24 and 30-34 year groups. The female CAs also tended to be below normative $\dot{V}O_{2max}$ data means for women from the USA aged 20-29 years (36.5 ± 0.4 ml·kg^{-1}·min^{-1}), 30-39 years (35.4 ± 0.4 ml·kg^{-1}·min^{-1}), and 40-49 years (34.4 ± 0.5 ml·kg^{-1}·min^{-1}) (45). The PT instructors for CAs should ensure that aerobic fitness is improved during the academy period, as it could directly influence some of the tasks required when working in a correctional facility (18, 20).

There are certain study limitations that should be acknowledged. This study only investigated CAs from one LEA, and the characteristics of CAs could vary across different agencies. Some of the assessments used by the LEA in assessing their CAs were relatively novel (e.g. the 201 m run). Future research could utilize other measures of fitness (e.g. flexibility, heart rate response to exercise, functional movement screening, etc.) that could be used to provide a greater overview of where CAs relate to the general and other tactical populations. Forthcoming research should also document whether these physical characteristics for CAs change following the academy training period.

Nevertheless, this is the first study that has documented the characteristics of CAs from a LEA. The results indicated that males were stronger in the hand grip, push-up, and sit-up tests, were faster over the 201 m and 2.4 km runs, and had a higher estimated $\dot{V}O_{2max}$. However, there were no differences in any of these assessments with regards to age for either males or females. The results from this study could be used to inform the training practices of CAs prior to the academy period, in addition to the program design adopted by PT instructors of CAs during the academy.

PRACTICAL APPLICATIONS

There are several practical applications that can be drawn from this study. Although CAs may not have to complete physical testing prior to being hired, they should attempt to improve their strength, strength endurance, and aerobic capacity to acceptable levels prior to the attending the academy. Academy training can be challenging, and individuals with lower fitness levels may not be able to successfully complete the tasks demanded of them during this period and may be at an increased risk of injury (23, 34, 38, 42). PT instructors for CAs should ensure their training programs are well-rounded and allow for the development of maximal strength and endurance, anaerobic power, and aerobic capacity. Individuals who work in correctional facilities may need to complete a range of different tasks that stress these capacities (18, 20), and their ability to complete these tasks could determine their own or their colleagues' well-being and safety. Future research should document the effects that academy training has upon the physical performance of CAs, and whether different forms of training, such as ability-based training (38), can elicit different adaptations.

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Table 1: Descriptive data (mean ± SD; 95% CI) for male and female custody assistants for age, body mass, grip strength for the left and right hands, number of push-ups and sit-ups in 60 seconds, times for the 201 m and 2.4 km runs, and estimated $\dot{V}O_{2max}$ derived from the 2.4 km run.

	Males (n = 69)	Females (n = 39)	*p*	*d*	*d* strength
Age (years)	27.54 ± 6.74 (25.92-29.16)	28.56 ± 7.13 (26.25-30.87)	0.458	0.15	Trivial
Body Mass (kg)	81.27 ± 15.22 (77.58-84.95)	65.68 ± 11.11* (62.08-69.28)	<0.001	1.17	Moderate
Grip Strength Left (kg)	46.26 ± 9.56 (43.45-49.06)	31.91 ± 4.83* (29.82-34.00)	<0.001	1.89	Large
Grip Strength Right (kg)	47.96 ± 9.70 (45.11-50.80)	34.17 ± 6.28* (31.46-36.89)	<0.001	1.69	Large
Push-ups (repetitions)	38.16 ± 12.29 (35.21-41.11)	18.54 ± 11.13* (14.93-22.14)	<0.001	1.67	Large
Sit-ups (repetitions)	39.23 ± 10.88 (36.62-41.84)	33.67 ± 14.16* (29.08-38.26)	0.024	0.44	Small
201 m run (sec)	34.51 ± 8.91 (32.36-36.67)	41.23 ± 6.03* (39.28-43.18)	<0.001	0.88	Moderate
2.4 km run (min:sec)	13:48 ± 3:12 (13:02-14:34)	16:30 ± 2:14* (14:47-16:13)	0.004	0.98	Moderate
$\dot{V}O_{2max}$ ($ml \cdot kg^{-1} \cdot min^{-1}$)	40.29 ± 10.38 (37.79-42.78)	34.25 ± 6.94* (32.00-36.50)	0.002	0.68	Moderate

* Significantly ($p < 0.05$) different from the males.

Table 2: Descriptive data (mean ± SD; 95% CI) for male custody assistants stratified by age (<24 years, 25-29 years, 30-34 years, and >35 years) for age, body mass, grip strength for the left and right hands, number of push-ups and sit-ups in 60 seconds, times for the 201 m and 2.4 km runs, and estimated $\dot{V}O_{2max}$ derived from the 2.4 km run.

	≤24 years (n = 27)	25-29 years (n = 24)	30-34 years (n = 5)	≥35 years (n = 13)
Age (years)	21.81 ± 1.71 (21.14-22.49)	26.88 ± 1.39 (26.29-27.46)	31.60 ± 1.34 (29.93-33.27)	39.08 ± 4.61 (36.29-41.86)
Body Mass (kg)	78.42 ± 14.31 (72.76-84.08)	84.77 ± 17.35 (77.27-92.27)	74.31 ± 9.81 (62.13-86.49)	83.66 ± 14.09 (75.15-92.17)
Grip Strength Left (kg)	46.58 ± 9.08 (42.20-50.95)	45.53 ± 9.41 (40.69-50.37)	35.50 ± 4.95 (8.97-79.97)	49.33 ± 10.90 (40.96-57.71)
Grip Strength Right (kg)	47.79 ± 10.57 (42.70-52.88)	47.47 ± 6.40 (44.18-50.76)	34.00 ± 5.66 (16.82-84.82)	52.33 ± 11.51 (43.49-61.18)
Push-ups (repetitions)	41.19 ± 11.16 (36.77-45.60)	35.92 ± 13.70 (30.13-41.70)	38.60 ± 8.76 (27.72-49.48)	35.85 ± 12.81 (28.11-43.58)
Sit-ups (repetitions)	39.56 ± 7.73 (36.50 ± 42.61)	39.58 ± 14.17 (33.60-45.57)	40.20 ± 14.15 (22.63-57.77)	37.54 ± 9.23 (31.96-43.11)
201 m run (sec)	32.38 ± 4.41 (30.60-34.17)	36.29 ± 13.60 (30.55-42.03)	36.00 ± 6.40 (28.05-43.95)	34.92 ± 4.17 (32.40-37.44)
2.4 km run (min:sec)	13:19 ± 2:08 (12:28-14:09)	13:56 ± 4:21 (12:06-15:46)	12:50 ± 2:08 (11:02-15:28)	14:57 ± 2:48 (13:15-16:39)
$\dot{V}O_{2max}$ ($ml \cdot kg^{-1} \cdot min^{-1}$)	41.93 ± 6.38 (39.40-44.45)	39.73 ± 14.51 (33.60-45.85)	43.93 ± 6.10 (36.35-51.51)	36.51 ± 8.89 (31.14-41.89)

Table 3: Pairwise effect size data for male custody assistants stratified by age (<24 years, 25-29 years, 30-34 years, and >35 years) for body mass, grip strength for the left and right hands, number of push-ups and sit-ups in 60 seconds, times for the 201 m and 2.4 km runs, and estimated $\dot{V}O_{2max}$ derived from the 2.4 km run.

	20-24 – 25-29	20-24 – 30-34	20-24 – 35+	25-29 – 30-34	25-29 – 35+	30-34 – 35+
Body Mass	0.40	0.34	0.37	0.74	0.07	0.77
Grip Strength Left	0.11	1.52§	0.27	1.33§	0.37	1.63§
Grip Strength Right	0.04	1.63§	0.41	2.23†	0.52	2.02§
Push-ups	0.42	0.26	0.44	0.23	0.01	0.25
Sit-ups	<0.01	0.06	0.24	0.04	0.17	0.22
201 m run	0.39	0.66*	0.59	0.03	0.14	0.20
2.4 km run	0.23	0.23	0.66*	0.32	0.28	0.85*
$\dot{V}O_{2max}$	0.20	0.32	0.70*	0.38	0.27	0.97*

* Moderate effect for the pairwise comparison.

§ Large effect for the pairwise comparison.

† Very large effect for the pairwise comparison.

Table 4: Descriptive data (mean ± SD; 95% CI) for female custody assistants stratified by age (<24 years, 25-29 years, 30-34 years, and >35 years) for age, body mass, grip strength for the left and right hands, number of push-ups and sit-ups in 60 seconds, times for the 201 m and 2.4 km runs, and estimated $\dot{V}O_{2max}$ derived from the 2.4 km run.

	≤24 years (n = 12)	25-29 years (n = 11)	30-34 years (n = 8)	≥35 years (n = 8)
Age (years)	21.00 ± 1.48 (20.06-21.94)	26.73 ± 1.68 (25.60-27.86)	31.38 ± 1.06 (30.49-32.26)	39.63 ± 3.85 (36.40-42.85)
Body Mass (kg)	62.06 ± 6.48 (57.94-66.17)	66.94 ± 11.00 (59.54-74.33)	69.81 ± 12.82 (59.09-80.52)	65.25 ± 14.90 (52.79-77.71)
Grip Strength Left (kg)	30.40 ± 0.89 (29.29-31.51)	31.25 ± 6.86 (25.51-36.99)	34.75 ± 2.87 (30.18-39.32)	32.17 ± 4.67 (27.27-37.06)
Grip Strength Right (kg)	33.00 ± 6.12 (25.40-40.60)	33.88 ± 8.43 (26.83-40.92)	37.25 ± 4.03 (30.84-43.66)	33.50 ± 4.97 (28.28-38.72)
Push-ups (repetitions)	16.33 ± 7.44 (11.61-21.06)	18.00 ± 7.89 (12.70-23.30)	21.88 ± 16.72 (7.90-35.85)	19.25 ± 13.95 (7.59-30.91)
Sit-ups (repetitions)	32.17 ± 6.21 (28.22-36.11)	37.64 ± 18.91 (24.93-50.34)	34.75 ± 11.93 (24.78-44.72)	29.38 ± 17.98 (14.34-44.41)
201 m run (sec)	41.33 ± 5.93 (37.57-45.10)	40.64 ± 2.94 (38.66-42.61)	39.75 ± 5.20 (35.40-44.10)	43.38 ± 9.71 (35.26-51.49)
2.4 km run (min:sec)	15:31 ± 2:28 (13:57-17:05)	15:51 ± 1:24 (14:55-16:48)	15:08 ± 2:12 (13:18-16:59)	15:23 ± 3:03 (12:50-17:56)
$\dot{V}O_{2max}$ ($ml \cdot kg^{-1} \cdot min^{-1}$)	34.83 ± 6.96 (30.40-39.25)	33.08 ± 4.43 (30.11-36.05)	34.57 ± 7.22 (28.54-40.61)	34.66 ± 10.10 (26.22-43.10)

Table 5: Pairwise effect size data for female custody assistants stratified by age (<24 years, 25-29 years, 30-34 years, and >35 years) for body mass, grip strength for the left and right hands, number of push-ups and sit-ups in 60 seconds, times for the 201 m and 2.4 km runs, and estimated $\dot{V}O_{2max}$ derived from the 2.4 km run.

	20-24 – 25-29	20-24 – 30-34	20-24 – 35+	25-29 – 30-34	25-29 – 35+	30-34 – 35+
Body Mass	0.54	0.76*	0.28	0.24	0.13	0.33
Grip Strength Left	0.17	2.05†	0.53	0.67*	0.16	0.67*
Grip Strength Right	0.12	0.82*	0.09	0.51	0.05	0.83*
Push-ups	0.22	0.43	0.26	0.30	0.11	0.17
Sit-ups	0.39	0.27	0.21	0.18	0.45	0.35
201 m run	0.15	0.28	0.25	0.21	0.38	0.47
2.4 km run	0.17	0.16	0.05	0.39	0.20	0.09
$\dot{V}O_{2max}$	0.30	0.04	0.02	0.25	0.20	0.01

* Moderate effect for the pairwise comparison.

† Very large effect for the pairwise comparison.