

## Association of Shorter and Longer Distance Sprint Running to Change of Direction Speed in Police Students

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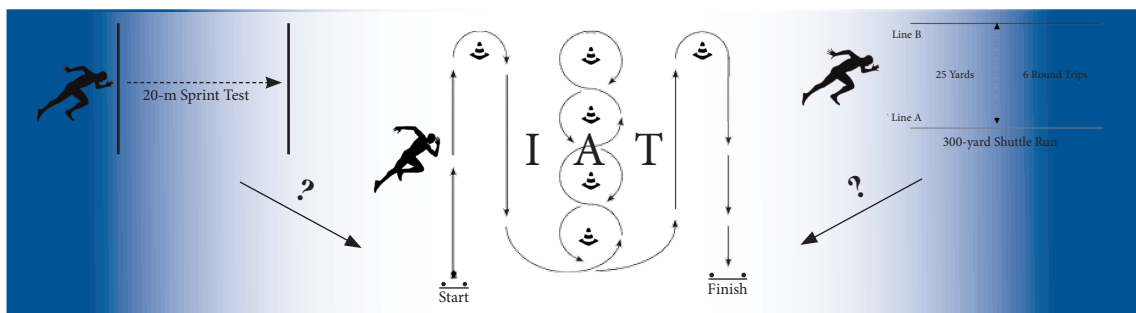
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**Abstract:** *Background.* Law enforcement officers may experience unique physical demands while on duty, including pursuing a suspect on foot, clearing obstacles, rapidly moving between covers, and engaging in physical confrontations with violent offenders. Several different change of direction speed (CODS) assessments are routinely used to simulate these demands. However, the relationship between these assessments has not been fully explored. Thus, this study investigated the association of shorter and longer distance sprint running with CODS performance. *Methods.* 15 police students ran the 20-m sprint test, 300-yard shuttle run, and Illinois Agility Test (IAT). Correlation and regression analyses were used to investigate associations. The effect size analysis provided the magnitude of associations. *Results.* Correlation analysis determined moderate association between 0-10 m, 10-20 m, and 0-20 m sprint performance with the IAT. The regression analysis determined strong linear association of IAT with sprint 0-10 m ( $R^2 = 0.488$ ,  $F = 12.385$ ,  $p = 0.004$ ), sprint 10-20 m ( $R^2 = 0.496$ ,  $F = 12.775$ ,  $p = 0.003$ ), sprint 0-20 m ( $R^2 = 0.573$ ,  $F = 17.468$ ,  $p = 0.001$ ), and no linear association with the 300-yard shuttle run. *Conclusions.* The current study found a significant positive association between short sprints and IAT performance, suggesting that linear sprinting speed determines a significant proportion of CODS performance. Therefore, police students and officers should include sprint training in their physical fitness routine.

**Keywords:** tactical fitness, occupational performance, law enforcement, agility.

### Graphical abstract



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## INTRODUCTION

Law enforcement officers may experience unique physical demands while on duty. These demands may include pursuing a suspect on foot, clearing obstacles, rapidly moving between covers, and engaging in physical confrontations with violent offenders (Anderson, 2001; Dawes et al., 2016). During such events, an officer must often accelerate, decelerate, and change directions, over short and long distances, in response to the movements and actions of an offender (Scofield & Kardouni, 2015). Based on the varied nature and physicality of these tasks, it is recommended that officers attain and maintain an adequate level of physical conditioning to be occupationally effective (Marins et al., 2019). For these reasons, cadets and police trainees often spend hours engaged in daily physical training during their time in the academy to prepare for the physical demands of police work (Čvoročić et al., 2021; Kukić et al., 2019; Reaves, 2016; Stojković et al., 2021).

Physical fitness assessments are typically a mandatory part of the recruitment process (Reaves, 2016). At the same time, many police agencies perform annual fitness assessments to facilitate officers' involvement in exercise programs (Reaves, 2016). Fitness assessments are used by police agencies to help recruit candidates capable of completing the academy training with the lowest risk of injury and the highest potential for job task performance. Once cadets become sworn officers, they should be able to perform their duties safely; therefore, they should remain fit for duty. Considering this, cardiorespiratory fitness, strength, and muscular endurance have been the most assessed attributes of police officers, followed by other performance components. These components may include body composition, power, flexibility, speed, agility, and anaerobic profile. Annual fitness test selection by law enforcement agencies depends on the occupational tasks officers face or may face while on duty. Therefore, some abilities may have higher priority than others.

Linear speed and change of direction speed (CODS) are essential attributes for officers to maintain both personal and public safety (Canetti et al., 2021). The Illinois Agility Test (IAT) and the 300-yard shuttle run are frequently used to measure fitness among police cadets because they mimic a sustained pursuit requiring frequent direction changes (Maupin et al., 2018; Orr et al., 2019; Papadakis et al., 2021). While the IAT simulates a suspect pursuit scenario that requires brief periods of acceleration, deceleration, and CODS over short distances (Post et al., 2022), the 300-yard shuttle run measures similar abilities over a greater distance. The 20-m sprint has also been investigated in previous studies (Aandstad et al., 2011; Canetti et al., 2021; Lockie et al., 2020). It has been shown to correlate to various occupational tasks, including a 4-foot (1.22-m) fence jump, victim drag, and getting up from a supine position (Canetti et al., 2021). However, the relationships between these three specific speed assessments have not been fully explored.

In fact, there is a dearth of research exploring the association of maximal running speed in anaerobic alactic and lactic conditions with CODS in tactical populations (e.g., police and military cadets and officers). Indeed, some research on the association of linear sprint ability with CODS performance in athletes exists (Köklü et al., 2015; Vescovi & McGuigan, 2008), but exploring this association in future police officers may be helpful when designing conditioning programs aimed at improving occupational fitness within this population. Therefore, this study aimed to investigate the association between shorter and longer distance sprint running and CODS performance. It was hypothesized that cadets' CODS performance would positively correlate with shorter sprint and 300-yard shuttle run performance.



## METHODS

### *Participants*

The Faculty of Security Studies, University of Banja Luka, Republic of Srpska, organized the study and informed their students about the aim of the study and testing procedures. Fifteen ( $n = 15$ ) students agreed to participate and signed the informed consent. The study was conducted with the approval from the Ethics Committee and in accordance with the Helsinki Declaration (World Medical Association, 2013).

### *Measurements and Procedures*

Students were required to visit the testing site on two separate occasions, with a between-occasion period of two days. They were also required to perform a maximal effort 20-m sprint and IAT on the first testing occasion and the maximal 300-yard shuttle run test on the second occasion. Participants performed two maximal trials of 20-m sprint and IAT. They were provided with two-minute rest between the 20-m sprint and three-minute rest between the IAT. The fastest trial was recorded to the nearest 0.10 s and used for the final analysis. Before commencing assessments, participants performed a 10-minute warm-up consisting of short running variations, calisthenics, and lower-body warm-up exercises. During the last phase of warm-up of the first testing day, participants performed two to three submaximal 20-m runs to a designated spot for the assessment, and three submaximal trials of IAT. Thus, this phase of warm-up was used for potentiation and familiarization. All tests were performed between 12:00 to 16:00 hours in an indoor training hall on a rubberized floor (tartan).

*20-m sprint test.* The 20-m sprint has been used to assess linear running speed in other research involving law enforcement populations (Canetti et al., 2021). Participants were instructed to run as fast as possible from the start line to the finish line from a standing position. The timing gates (Physical ability test 02, UNO-LEX, NS, Serbia) were positioned at the start, 10-m, and 20-m marks, so the time for the first 10-m (sprint 0-10 m acceleration), second 10-m (sprint 10-20 m maximal running speed), and the overall 20-m distance (sprint 0-20 m) could be measured.

*Illinois Agility Test.* The IAT was employed five to 10 minutes after the 20-m sprint test to assess CODS of participants following methods previously established (Hachana et al., 2013; Lockie et al., 2013; Roozen, 2004). Four cones were placed in a rectangular shape 10-m long by 5-m wide. At the 2.5-m mark (centre) within the rectangle, four more cones were placed 3.3-m apart from each other. A pair of timing gates were placed at the start and finish lines, respectively. The gates were placed about 2-m apart at a height set at 0.5-m. Participants began the test from a standing position 50-cm behind the start line on the left side of the rectangle. They then ran straight ahead to the far-left cone, turned around it before returning to the first of four centre cones. Participants weaved between cones to the far centre cone before returning the same way to the first centre cone and cutting to the far right marker. The test concluded when the participant ran back to the right-side cone indicating the finish line. Participants were not allowed to skip or run over the cones; they were instructed to run around them. The prescribed route had to be followed in its



entirety. The trial stopped and was reattempted after a requisite recovery period when a participant failed to follow the prescribed protocol.

*300-yard shuttle run.* The 300-yard shuttle run test was utilized to assess lactic running capabilities. Participants were instructed to perform a shuttle run between two cones placed 25 yards apart. Participants were instructed to complete this test as quickly as possible for a total of six shuttles. One tester provided verbal encouragement for each participant. Timing gates were used to measure time to completion to the nearest 0.10 sec. The time to complete the test was recorded for analysis.

### Statistical analyses

All data were entered into a Microsoft Excel file first before statistical analyses were conducted in R Statistics version 4.1.0. Descriptive statistics were calculated for mean, standard deviation, coefficient of variation, minimum, and maximum values. The normality of data distribution was tested using the Shapiro-Wilk test. All data were normally distributed ( $p = 0.08 - 0.58$ ). Pearson correlational analysis was used to investigate the association of CODS and linear sprints running. Linear regression analysis determined the causality of association. The significance was set at  $p < 0.05$ . Cohen's effect size was used to qualify the magnitude of correlation coefficients as small ( $r = 0.2-0.5$ ), moderate ( $r = 0.5-0.8$ ), and large ( $r > 0.8$ ) and of regression coefficients as small ( $R^2 = 0.04-0.25$ ), moderate ( $R^2 = 0.25-0.64$ ), and large ( $R^2 = 0.64$  and stronger) (Sullivan & Feinn, 2012).

## RESULTS

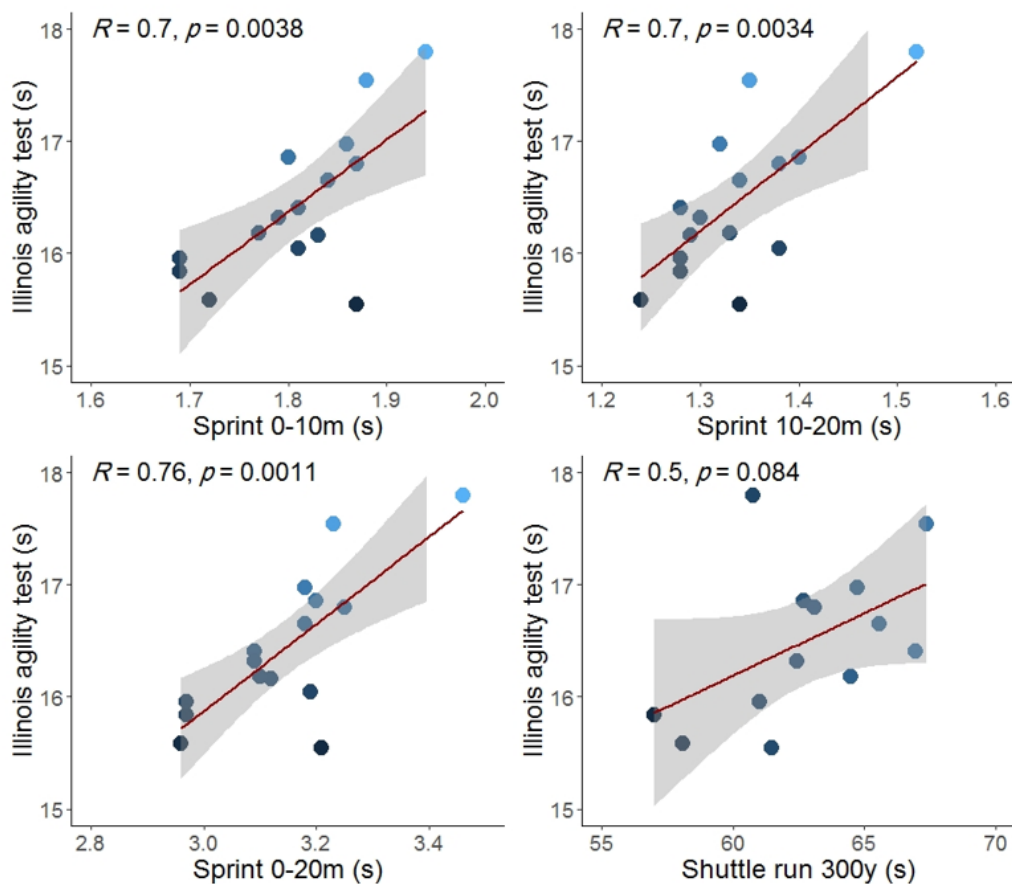
Cadet performance of the 20-m sprint, 300-yard shuttle run, and IAT are shown in Table 1. All coefficients of variations were below 10%, suggesting good data homogeneity.

**Table 1.** Descriptive Statistics for the 20-m Sprint, 300-Yard Shuttle Run, and IAT

Variables	Mean	Standard Deviation	Minimum	Maximum	95% Confidence int.	
					Upper	Lower
0-10 m (s)	1.80	0.10	1.59	1.99	15.14	17.74
10-20 m (s)	1.34	0.09	1.23	1.62	1.67	1.95
0-20 m (s)	3.14	0.17	2.84	3.56	1.20	1.47
300-Yard Shuttle Run (s)	64.19	4.79	57.01	74.14	2.89	3.40
IAT (s)	16.54	0.76	15.48	18.27	54.80	73.58

Correlation analysis determined a moderate association of 0-10 m, 10-20 m, and 20-m sprint running performance with IAT (Figure 1). The strongest association occurred between the sprint 0-20 m and IAT, followed by the association of IAT with sprint 10-20 m and 0-10 m. The regression analysis determined strong linear association of IAT with sprint 0-10 m ( $R^2 = 0.488$ ,  $F = 12.385$ ,  $p = 0.004$ ), sprint 10-20 m ( $R^2 = 0.496$ ,  $F = 12.775$ ,  $p = 0.003$ ), sprint 0-20 m ( $R^2 = 0.573$ ,  $F = 17.468$ ,  $p = 0.001$ ), and no linear association with the 300-yard shuttle run.





**Figure 1.** Scatter Plot Showing the Associations of IAT with Sprint Runs and 300-Yard Shuttle Run

## DISCUSSION

Police academy training should prepare cadets for incumbent officers varied and dynamic duties. CODS is a valuable measure that may be directly associated with occupational duties such as pursuing a suspect on foot, clearing obstacles, and moving between covers. The current study found a significant positive association between 20-m sprints and IAT performance. These results suggest that linear sprinting speed determines a significant portion of CODS performance in police cadets preparing to become police officers. Therefore, not only those who sprint faster may be able to perform tasks requiring straight sprint more efficiently, but also tasks that require CODS. Considering this, training that incorporates sprinting could lead to increased occupational preparedness in cadets and incumbent officers alike. Therefore, the relationship between linear sprints and CODS should be considered when implementing physical fitness for duty assessments.

These findings are similar to Canetti et al. (2021) who reported significant correlations between metabolic fitness and occupational task performance among 106 incumbent officers. The authors found significant ( $p < 0.001$ ) associations between 10- and 20-m sprint



performance and police occupational tasks, including a fence jump, victim drag, and get up, whereby these predicted approximately 40% of the performance in the occupational tasks analysed. Therefore, sprint performance appears to contribute to CODS and occupational task performance (Lockie et al., 2018; Orr et al., 2019). Accordingly, academy and officer fitness training should encompass these abilities.

The current body of literature suggests that academy training may not adequately prepare officers for occupational demands (Dawes et al., 2021). Moreover, cadets and officers may not understand what training is required to encourage optimal health and performance-related physical fitness. To that end, academies and agencies may consider implementing training programs adjustable to cadets' and officers' needs and fitness status (Kukić & Čvorović, 2019; Stojković et al., 2021). Thus, to prepare cadets the best for their future job demands, all three types of speed training should be implemented in training.

### LIMITATIONS AND FUTURE CONSIDERATIONS

While the authors believe this is the first study to explore the relationships between these three speed assessments among law enforcement cadets, certain study limitations must be considered. This study analysed police students in three anaerobic fitness tests. Notably, incumbent officers' performance in these tests may differ from the current research, especially as officer's fitness has been shown to decline in older age groups. While the IAT is widely administered in law enforcement populations, the 300-yard shuttle run and the 20-m sprint are used less often. Moreover, cadet body composition was not considered in this research. Body composition has been shown to play an essential role in physical performance and CODS in tactical populations. Lastly, the study sample was small and only included male cadets. Previous research indicates differences in CODS abilities between men and women. Consequently, the relationships of these tests with sex should be explored.

### PRACTICAL APPLICATION

Several practical applications can be drawn from this research. Our findings suggest that sprint speed and CODS are closely associated. Since linear and CODS are essential occupational physical abilities, officers and cadets should incorporate all three types of speed training into regular physical fitness training. Law enforcement agencies should provide technical advice and training to assist officers in performing sprint-based training in their physical training programs to enhance occupational readiness.

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The authors have no conflicts of interest to declare.



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