



A Pilot Analysis of the Influence of Lower-Body Strength and Power During Law Enforcement Tasks Under Load

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ABSTRACT

INTRODUCTION: Many law enforcement agencies require recruits to complete assessments that test their underlying fitness characteristics as they relate to job tasks. These tests are administered without personal protective equipment (PPE typically 8-10 kg of added external load). PPE load could lead to a decrease in task performance. In this pilot study the decrease between unloaded and loaded performance is referred to as the tactical deficit. Lower-body strength and power could mitigate the tactical deficit created by PPE. **PURPOSE:** To examine the effects of load carriage during policing tasks and investigate whether dynamic and isometric lower-body strength or power can lessen the tactical deficit. **METHODS:** Ten college students (7 males, 3 females) from one university were recruited and age-matched to typical law enforcement recruits. This pilot study comprised of three sessions across three days. Session 1 consisted of a standing broad jump (SBJ), isometric leg/back dynamometer (LBD), and a one-repetition maximum hexagonal bar deadlift. In sessions 2 and 3, subjects completed four police tasks either loaded or unloaded: a vertical jump, 75-yard pursuit run (75PR), a 9.75-m body drag (BD), and a 500-yard run. In the loaded condition, participants wore 8-10 kg of mandated officer PPE. Additionally, a vertical jump in the unloaded condition was included as part of the power measures. Dependent t-tests calculated differences in unloaded and loaded condition times ($p < 0.05$). Tactical deficit was then calculated, which was expressed as an absolute value percentage difference via the formula: $(\text{loaded time} \div \text{unloaded time} \times 100) - 100$. Partial correlations controlling for sex analyzed relationships between relative and absolute isometric and dynamic strength (LBD and hexagonal bar deadlift, respectively), SBJ, and vertical jump height and peak power (PAPw), derived from jump height, with the tactical deficit for each of the police tasks. **RESULTS:** There were significant differences in performance between the unloaded and loaded conditions for the vertical jump (~ 7.53 cm lower jump height, $p < 0.001$, tactical deficit = $13.02 \pm 6.25\%$), 75PR (~ 0.92 s slower, $p = 0.03$, tactical deficit = $5.11 \pm 6.53\%$), and the 500-yard run (~ 12.05 s slower, $p = 0.01$, tactical deficit = $13.09 \pm 13.20\%$). No significant differences were found for the BD (~ 0.42 s slower, $p = 0.36$, tactical deficit = $11.16 \pm 19.06\%$), although the loaded performance was slower. There was a moderate negative relationship between 75PR tactical deficit with VJ height ($r = -0.62$, $p = 0.01$) and PAPw ($r = -0.65$, $p = 0.05$). For absolute LBD, there was a large negative relationship for tactical deficits with 75PR ($r = -0.78$, $p = 0.01$) and a moderate negative relationship with BD ($r = -0.67$, $p = 0.04$). For relative LBD, there was a large negative relationship with 75PR tactical deficits ($r = -0.75$, $p = 0.01$). **CONCLUSIONS:** This pilot analysis showed that PPE typically decreased performance when completing police tasks. Subjects that were more powerful had a lower tactical deficit in the 75PR, which is a job task that requires explosive power for efficient execution. Greater lower-body isometric strength also appeared to mitigate the tactical deficit in the BD and 75PR. **PRACTICAL APPLICATIONS:** This data suggests law enforcement training staff should focus on developing lower-body strength and power to sustain the demands of PPE and decrease the tactical deficit in foot pursuit and dragging tasks.

INTRODUCTION

- Many law enforcement agencies require recruits to complete assessments that test their underlying fitness characteristics as they relate to job tasks.
- These tests are typically administered without personal protective equipment (PPE) which is ~ 8 -10 kg of added external load (1).
- PPE load could lead to a decrease in task performance as a result of increased physiological burden or if an officer is not strong or powerful enough to attenuate the additional load (2).
- In this pilot study the decrease between unloaded and loaded performance is referred to as the tactical deficit (TD).
- Lower-body strength and power could mitigate the tactical deficit created by PPE (3,4), and in turn result in officers being able to execute their job tasks more effectively and efficiently.
- The purpose of this pilot study was to examine the effects of load carriage during policing tasks and investigate whether dynamic and isometric lower-body strength or power can lessen the TD.

METHODS

- Ten college students (7 males: age: 23.29 ± 3.14 years; height: 169.29 ± 4.92 cm; body mass: 73.29 ± 8.95 kg); 3 females: age: 23.67 ± 1.15 years; height: 163 ± 7 cm; body mass: 66.7 ± 4.7 kg) from one university were recruited and age-matched to typical law enforcement recruits. This pilot study comprised of three testing sessions across three days.
- Session 1: standing broad jump (SBJ), isometric leg/back dynamometer (LBD), and a one-repetition maximum hexagonal bar deadlift.
- Sessions 2 and 3: subjects completed four police tasks either loaded or unloaded: a vertical jump, 75-yard pursuit run (75PR), a 9.75-m body drag (BD), and a 500-yard run. In the loaded condition, participants wore 8-10 kg of mandated officer PPE. A vertical jump in the unloaded condition (UNL VJ) was included as part of the power measures. These tests were selected due to their common occurrence in the field.
- Data was combined for the sexes and dependent t-tests calculated differences in unloaded and loaded condition times ($p < 0.05$). Tactical deficit was then calculated and expressed as an absolute value percentage difference via the formula: $(\text{loaded time} \div \text{unloaded time} \times 100) - 100$.
- Partial correlations controlling for sex analyzed relationships between relative and absolute isometric and dynamic strength (LBD and hexagonal bar deadlift, respectively), SBJ, and vertical jump height and peak power (PAPw), derived from jump height, with the tactical deficit for each of the police tasks.

RESULTS

- There were significant differences in performance between the unloaded and loaded conditions for the VJ, BD, and 500R (Table 1).
- There were moderate-to-strong correlations between LBD, relative LBD, UNLVJ, and PAPw for the 75PR TD (Table 2).
- There was a moderate correlation between LBD and BD TD.

Table 1. Dependent t-tests between the unloaded and loaded conditions.

Variable	Unloaded	Loaded	p-value
VJ (cm)	53.61 ± 13.49	46.35 ± 11.08	.000*
75PR (s)	18.18 ± 1.31	19.10 ± 1.78	.039*
BD (s)	6.83 ± 2.74	7.25 ± 1.89	.360
500R (s)	93.38 ± 17.76	105.44 ± 23.49	.014*

*Indicates significant differences between the conditions

Table 2. Partial correlations controlling for sex for performance measures and job tasks.

Variable		UNLVJ TD	75PR TD	BD TD	500R TD
SBJ	r	.376	-.620	-.490	-.402
Relative SBJ	r	.479	-.484	-.199	-0.011
LBD	r	.140	-.788*	-.676*	-.455
Relative LBD	r	.241	-.758*	-.502	-.191
HBDL	r	.245	-.555	-.616	-.520
Relative HBDL	r	.466	-.594	-.511	-.300
UNL VJ	r	.037	-.767*	-.480	-.258
PAPw	r	-.106	-.651*	-.598	-.540
P:BM	r	.081	-.712	-.346	-.082

*Indicates significant relationships.

CONCLUSION

- This pilot analysis showed that PPE typically decreased performance when completing police tasks. Subjects that were more powerful had a lower tactical deficit in the 75PR. Greater lower-body isometric strength also appeared to mitigate the tactical deficit in the BD and 75PR.
- Rate of force development is essential to change of direction (COD) tasks, such as the 75PR (4). Higher levels of power results in greater force production, which could assist in attenuating TD in COD tasks.
- Lower-body power is essential for backwards propulsion during dragging tasks (3). Officers who have higher levels of lower-body power may be able to sustain the load of PPE while completing a body drag efficiently.

PRACTICAL APPLICATIONS

- This data suggests law enforcement training staff should focus on developing lower-body strength and power to sustain the demands of PPE and decrease the TD in foot pursuit and dragging tasks.
- Additionally, law enforcement agencies could implement training with mandated PPE to not only familiarize recruits to the weight of the PPE, but also as a method of physical training to build strength.

References

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