AEROBIC ENDURANCE IS MORE HIGHLY RELATED TO LOAD CARRIAGE PERFORMANCE THAN STRENGTH AND POWER

Robin Orr[1,2] Jeremy Robinson[3], Shane Irving[3], & Adam Roberts [3]

[1]Faculty of Health Sciences & Medicine, Bond Institute of Health and Sport, Bond University, Gold Coast QLD 4229, Australia
[2]Tactical Research Unit, Bond University, Gold Coast QLD 4229, Australia
[3]Australian Federal Police, Australia

https://bond.edu.au/tru

BOND UNIVERSITY
TACTICAL RESEARCH UNIT

Background

- SWAT police officers are required to carry external loads ranging from 22 to 27 kg as part of their occupation [1,2]
- These loads consist of specialist weapons, body armour, communications equipment, flashlights, specialist breaching equipment and ballistic shields [1-3]
- The impact of these loads include decreasing the mobility [3] and potential lethality [4] of SWAT officers
- One means of preparing officers to carry loads is through physical conditioning. [5]

BOND UNIVERSITY
TACTICAL RESEARCH UNIT

Aim

The aim of this study was to investigate whether strength, power or aerobic endurance had the greatest association with load carriage performance in SWAT Police Officers.

BOND UNIVERSITY
TACTICAL RESEARCH UNIT

Methods

Population

- n = 42♂ SWAT
- Body weight = 88.8±8.25 kg

Ethics approved under Bond University Research Ethics Committee Protocol Number: RO1585

Outcome measures

- STRENGTH (1RM Protocol)
  - Bench Press / Squat / Deadlift/ Pull-up
- POWER
  - VJ /10m Sprint
- AEROBIC FITNESS
  - 20m PSRT
- LOAD CARRIAGE
  - 3 x 5 km with 25 km AFAP

BOND UNIVERSITY
TACTICAL RESEARCH UNIT

Methods

Design

- Longitudinal cohort study with benchmark measures collected over a period of two weeks
  - Strength testing conducted over 2 days in the first week (Day 1 - Bench press and deadlift: Day 2 - Squat and pull-up)
  - Power over two days in the second week (Day 1 – VJ and 10m sprint: Day 2 - Beep test)
  - The marches were completed at three to four-month intervals in June 2011, September 2011 and January 2012.

Statistical Analysis

- Pearson's correlations to investigate relationships
- An ANOVA was used to detect changes in load carriage
- Alpha levels were set at 0.05 a priori.

BOND UNIVERSITY
TACTICAL RESEARCH UNIT

Results

Table 1: Descriptive data for all measures

1RM Bench Press (kg)	109.67 ± 19.80
Bench Ratio (%)	1.24 ± 0.20
1RM Squat (kg)	125.79 ± 24.53
Squat Ratio (%)	1.42 ± 0.25
1RM Deadlift (kg)	151.64 ± 26.31
Deadlift Ratio (%)	1.71 ± 0.25
1RM Pullup (kg)	121.43 ± 14.91
Pullup Ratio (%)	1.37 ± 0.15
Vertical Jump (cm)	50.21 ± 5.88
10m (secs)	1.88 ± 0.10
Shuttle Run (Level)	11.30 ± 1.07
Pack March 1 (mins:sec)	44.00 ± 1.50
Pack March 2 (mins:sec)	43.12 ± 1.76*
Pack March 3 (mins:sec)	42.48 ± 1.99**

* Significantly faster than March 1
* Significantly faster than March 2

BOND UNIVERSITY
TACTICAL RESEARCH UNIT

Results

Table 2: Correlations between load carriage performance and all baseline measures.

Measure	Pack March 1 (mins:sec)	Pack March 2 (mins:sec)	Pack March 3 (mins:sec)
1RM Bench Press (kg)	-.360*	-.318*	-.295*
Bench Ratio (%)	-.465**	-.365*	-.379**
1RM Squat (kg)	-.401**	-.335*	-.316*
Squat Ratio (%)	-.500**	-.381**	-.396**
1RM Deadlift (kg)	-.288*	-0.248	-0.215
Deadlift Ratio (%)	-.403**	-.294*	-.305*
1RM Pull-up (kg)	-.452**	-.439**	-.416**
Pull-up Ratio (%)	-.607**	-.512**	-.541**
Vertical Jump (cm)	-.501**	-.541**	-.523**
10 meter sprint	.373*	0.178	0.217

** Correlation is significant at the 0.01 level (2-tailed).

BOND UNIVERSITY
TACTICAL RESEARCH UNIT

Results

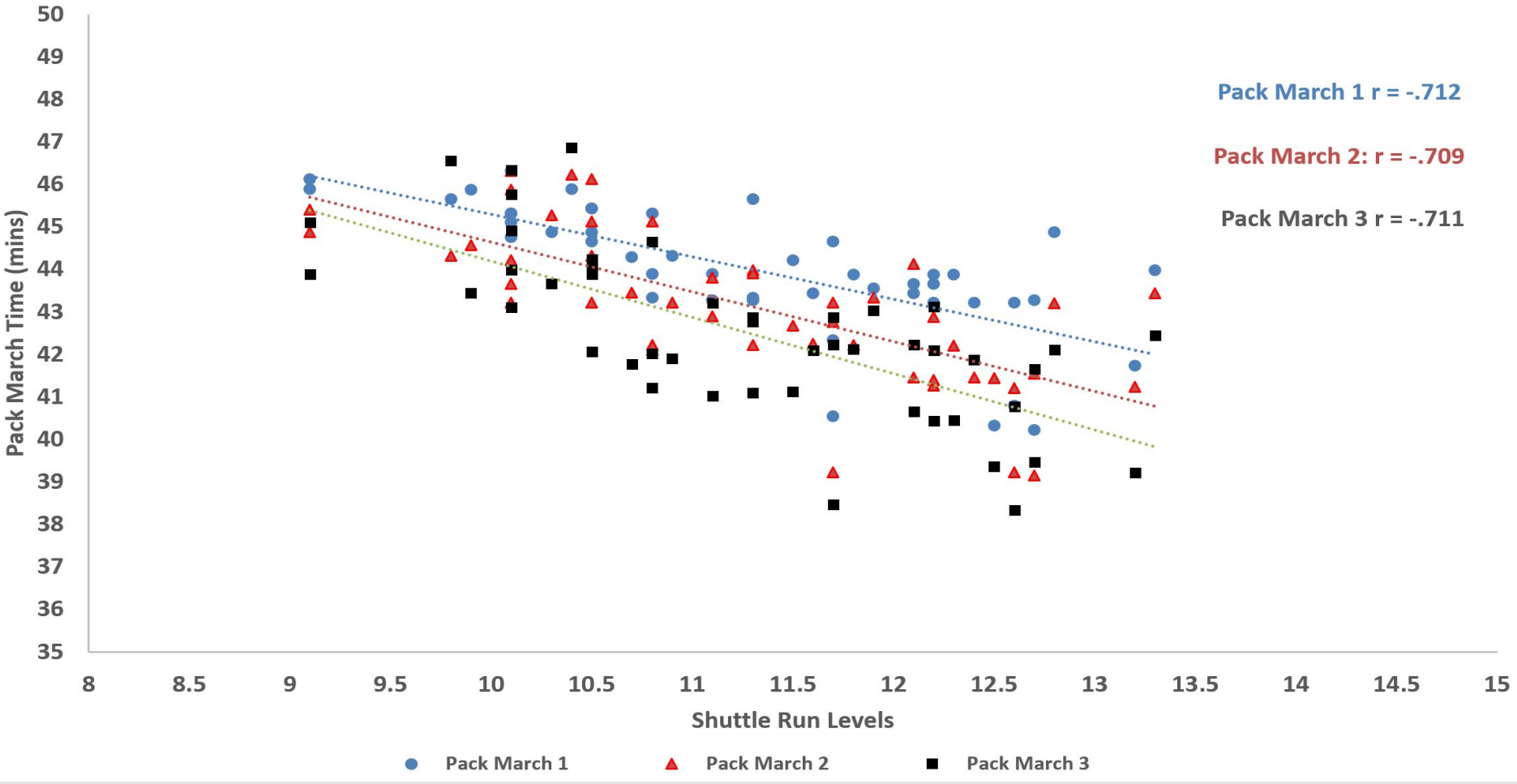
Table 2: Correlations between load carriage performance and all baseline measures.

Measure	Pack March 1 (mins:sec)	Pack March 2 (mins:sec)	Pack March 3 (mins:sec)
Pack March 1 (mins:sec)	1	.840**	.815**
Pack March 2 (mins:sec)	.840**	1	.881**
Pack March 3 (mins:sec)	.815**	.881**	1
Shuttle Run (Level)	-.712**	-.709**	-.711**

** Correlation is significant at the 0.01 level (2-tailed).

BOND UNIVERSITY
TACTICAL RESEARCH UNIT

Results



BOND UNIVERSITY
TACTICAL RESEARCH UNIT

Discussion

- Load carriage specific training is known to be the most effective form of training for load carriage [5,6]
- A program of aerobic and strength training combined is next best [5,6]
- Training to improve aerobic fitness may be better than strength training with heavy load carriage known to increase aerobic fitness [7]
  - But must they have a minimum standard of strength?
- Relative strength gains may be more important than absolute strength gains

BOND UNIVERSITY
TACTICAL RESEARCH UNIT

Conclusion

- This is the first known study to have reported on the fitness measures associated with elite law enforcement group load carriage events over time

- Practical Applications
  - The previously proposed means of conditioning for load carriage are supported [5,6]

BOND UNIVERSITY
TACTICAL RESEARCH UNIT

References

1. Blacker SD, Carter JM, Wilkinson DM, Richmond VL, Rayson MP, Peattie M. Physiological responses of Police Officers during job simulations wearing chemical, biological, radiological and nuclear personal protective equipment. Ergonomics 56(1):137-47, 2013.
2. Carlton SD, Carbone PD, Stierli M, Orr RM. The Impact of Occupational Load Carriage on the Mobility of the Tactical Police Officer. Journal of Australian Strength & Conditioning 22(1):32-7, 2014.
3. Dempsey PC, Handcock PJ, Rehrer NJ. Impact of police body armour and equipment on mobility. Applied ergonomics 44:957-61, 2013.
4. Carbone PD, Carlton SD, Stierli M, Orr RM. The impact of load carriage on the marksmanship of the tactical police officer: A pilot study. Journal of Australian Strength and Conditioning 22(2): 50-7, 2014.
5. Orr R, Pope R, Johnston V, Coyle J. Load carriage: Minimising soldier injuries through physical conditioning-A narrative review. Journal of military and veterans' health 18(3): 31-8, 2010.
6. Knapik, Joseph J, Everett A Harman, Ryan A Steelman, and Bria S Graham. "A Systematic Review of the Effects of Physical Training on Load Carriage Performance." The Journal of Strength & Conditioning Research 26, no. 2 (2012): 585-97.
7. Rudzki, S.J. "Weight-Load Marching as a Method of Conditioning Australian Army Recruits." Mil Med 154, no. 4 (1989): 201-5.

Questions

Future correspondence can be made via:
rorr@bond.edu.au