Contributions From Critical Speed, Body Composition, And Lower Body Strength To Load Carriage Performance

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Introduction

Load carriage is inherent in the tactical population, and the mass required can depend on the occupation (5). Critical speed (CS) has been associated with technical and combat-specific performance measures (e.g., loaded running)(1,2,4,8). The 3-min all-out exercise test (3MT) provides estimates of CS and the maximal capacity to displace the body (*D*') at speeds above CS (7). Loaded time trials can be used in tactical populations for an aerobic and load carriage (LC) performance assessment, along with body composition and lower body strength to measure physical performance (3,6).

Methods

Researchers collected data from twenty-two young adults that underwent various assessments that included a running 3MT to determine CS and *D*', isokinetic knee extension (KE) muscle strength and endurance on a Biodex System, body composition (BC) assessed by dual-energy X-ray absorption (DXA), and two load carriage (21 kg) time trials (LCTT) of 400 m and 3200 m, respectively (Figure 1). Pearson's Product-Moment Correlations investigated relationships between CS, *D*', BC, thigh lean mass (TLM), and lower-body strength parameters. Stepwise multiple linear regression analyses were used to determine the relationship between selected predictor variables (lean body mass (LBM), % body fat, TLM, CS, *D*', KE peak torque, and KE endurance work) and which variables predicted LC time-trial performance.

Results

Descriptive data (mean ± standard deviation) for the sample (Table 1). The stepwise regression analyses indicated that CS and LBM contributed significantly to predicting 3200m LCTT (F [2,19] = 81.85, R^2 = 0.84, p<0.001) with β coefficients (-0.723 and -0.301, respectively) (Table 2) and TLM contributed significantly to predicting the 400m LCTT (F [1,20] = 46.586, R^2 = 0.70, p<0.001) (Table 3). Significant correlations, in descending order, were as follows: LBM and CS (r= 0.651, p<0.001), KE endurance work and CS (r= 0.645, p<0.001), TLM and CS (r=0.593, p<0.05), and KE peak torque and CS (r= 0.529, p<0.05) (Figure 2).

Critical Speed & Lean Body Mass are Significant in Predicting Load Carriage Time-Trial Performance

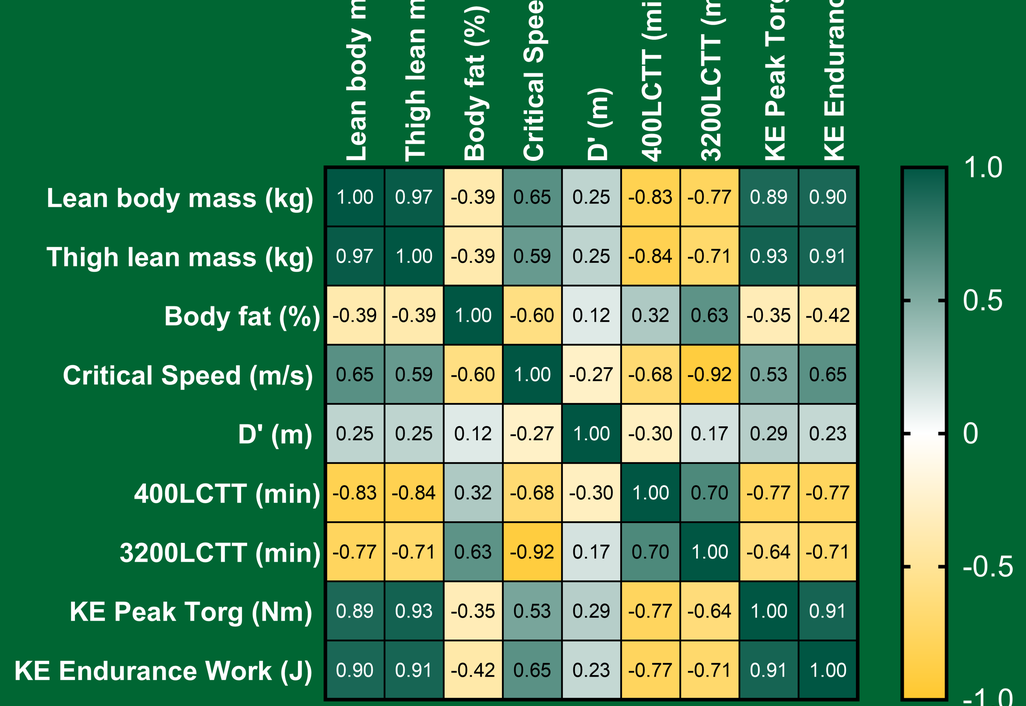


Figure 2: Pearson's Product-Moment Correlations

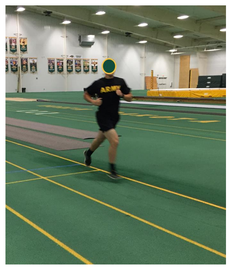
Lean Body Mass, Lower Body Muscle Strength & Endurance Contribute to Critical Speed

References

Participants	22, female = 6
Age (yrs)	20.8 ± 1.6
Body mass (kg)	76.7 ± 11.7
Body fat (%)	21.7 ± 7.1
Lean body mass (kg)	56.4 ± 11.2
Thigh lean mass (kg)	8.0 ± 1.6
Critical Speed (m/s)	3.5 ± 0.6
D' (m)	154.1 ± 40.7
KE peak torque (Nm)	216.1 ± 57.0
KE endurance work (J)	2404 ± 539.6
400m LCTT (mins)	1.6 ± 0.3
3200m LCTT (mins)	20.8 ± 3.9

Table 1: Descriptive data (Mean ± SD)

A.



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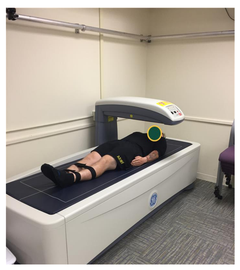

Figure 1: Data Collection using 3-min all-out exercise test (A) and dual-energy X-ray (B)

Variable	B	SEB	β
Constant	43.686***	2.22	
CS (m/s)	-5.087***	0.686	-0.723
LBM (kg)	-0.104*	0.034	-0.301

SEB, standard error for the unstandardized beta.
CS: critical speed, LBM: lean body mass
Note: R^2 = 0.84; adjusted R^2 = 0.83
*p < 0.05; **p < 0.01, ***p<0.001

Table 2: Stepwise Regression Model 3200m LCTT

Variable	B	SEB	β
Constant	2.938***	0.197	
Thigh Lean Mass (kg)	-0.166***	0.024	-0.836

SEB, standard error for the unstandardized beta.
Note: R^2 = 0.70; adjusted R^2 = 0.69, ***p<0.001

Table 3: Stepwise Regression Model 400m LCTT

Conclusion

The findings of this study support that CS and LBM, including TLM, are important in predicting load carriage completion in the time-trial tasks. In addition to LBM, muscle strength and endurance contribute to CS and should be considered when training for load carriage tasks.