Maximal isometric lower body strength and vertical jump performance in starting and bench semi-elite male basketball players

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2 authors:

Frans H Van der Merwe
Waikato Institute of Technology

Michael E Mann
The Universal College of Learning

MAXIMAL ISOMETRIC LOWERBODY STRENGTH AND VERTICAL JUMP PERFORMANCE IN STARTING AND BENCH SEMI-ELITE MALE BASKETBALL PLAYERS

Frans van der Merwe✉ , Michael Mann
Department of Exercise & Sport Science, UCOL, Palmerston North, New Zealand
✉F.vandermerwe@ucol.ac.nz
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INTRODUCTION

Basketball is a court-based sport consisting of high intensity, powerful activities such as jumping, change of direction (COD), sprinting as well as sport specific movements (10). Research has found that different basketball playing positions showcase different strength, power, speed and agility characteristics relative to their demands (2) and that individuals who are stronger, jump higher, are faster or more agile in general played more minutes than other individuals in their position (4). The optimal development of a basketballer's strength, power, speed and COD would thus appear to be beneficial to performance.

The interaction between strength, power and COD is gaining more attention of late from both researchers and strength and conditioning practitioners who are all looking to give their athletes the edge (1, 6). A number of these studies have investigated the relationship between isometric strength and power to vertical jump performance (7, 11).

The differences in maximal isometric lower body strength and vertical jump performance in starting and bench basketball players has not been examined before. Therefore, the comparison of isometric lower body strength and power is required to identify whether specific physical qualities differentiate between these athletes. This will allow coaches to identify weaknesses within muscular performance and implement specific training protocols to develop these qualities to an appropriate standard.

METHODS

Design: Observational cross-sectional analysis

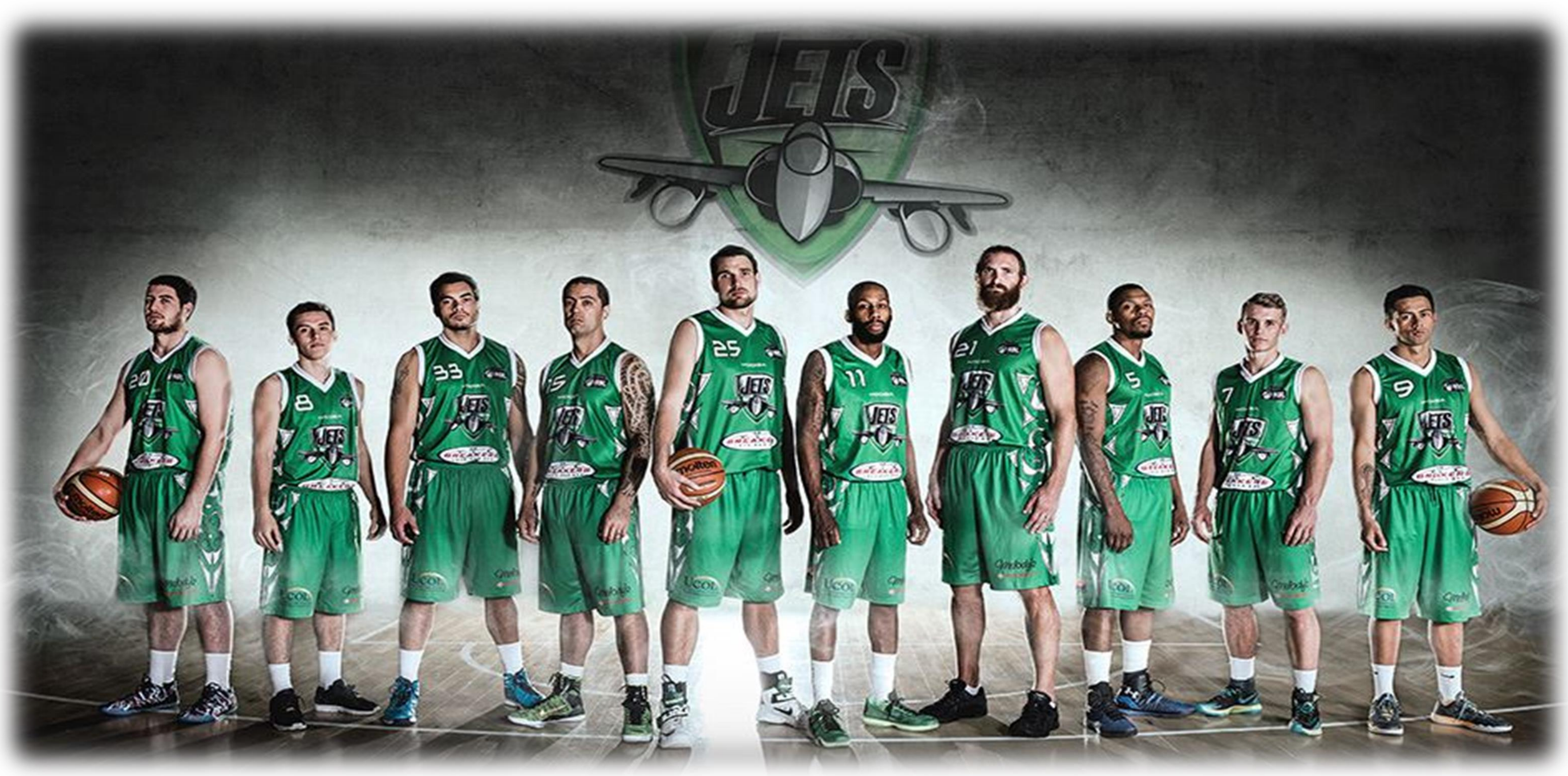
Subjects: 10 semi-professional male basketball players, five starting (24.8±3.7yrs; 196.2±9.6cm; 96.96±16.82kg),and five bench players (20.6±1.5yrs; 196.2±6.2cm; 90.36±14.33kg) with a minimum of one year experience playing at the semi-professional level.

Testing: All tests were performed during a single testing session following 48 hrs of rest. Tests performed were:

- Squat Jump (*Jump height, Peak force, Peak velocity, Peak power*)
- Countermovement Jump (*Jump height, Peak force, Peak velocity, Peak power*)
- Isometric Mid-thigh Pull (*Peak force, max Rate of force development, Impulse100, Impulse200, Impulse 300, Total impulse*)

Squat jump, countermovement jump and Isometric mid-thigh pull variables was determined using a portable force plate sampling at 600 Hz (400 Series Performance Plate, Fitness Technology, Adelaide, Australia) with data interpreted using the Ballistic Measurement system software (Fitness Technology. Adelaide, Australia).

Analysis: Two-tailed independent *t* tests were used to assess the differences between the means of the starter and bench groups (5). Effect sizes were also calculated according to Cohen's *d* formula. Effect sizes were interpreted as trivial (< 0.19), small (0.20 – 0.59), moderate (0.60 – 1.19), large (1.20 – 1.99), and very large (2.0 – 4.0)(3). Additionally, 95% confidence intervals were used to ascertain the certainty with which effects occurred.



RESULTS

Table 1 - Comparison between starting and bench semi-professional basketball players in relative isometric mid-thigh pull, countermovement jump, and squat jump force-time velocity-time variables.

	Starters (*n* = 5)	Bench (*n* = 5)	*p value*	Cohen Effect Size [95% CI]
Body Mass (kg)	96.96 ± 16.82	90.36 ± 10.28	0.52	0.47 [-13.73, 26.93]
Age (years)	24.80 ± 3.71	20.60 ± 1.50	0.09	1.48** [0.07, 8.33]
Isometric mid-thigh pull				
IPF ($N.kg^{-1}$)	29.77 ± 2.68	30.84 ± 4.85	0.71	-0.27 [-6.78, 4.64]
mRFD ($N.kg^{-1}.s^{-1}$)	152.06 ± 69.00	125.54 ± 31.87	0.51	0.49 [-51.86, 104.90]
I100 (N.kg.s)	1.23 ± 0.13	1.07 ± 0.11	0.09	1.33** [-0.02, 0.34]
I200 (N.kg.s)	2.79 ± 0.57	2.16 ± 0.26	0.09	1.42** [-0.02, 1.28]
I300 (N.kg.s)	4.63 ± 1.21	3.33 ± 0.54	0.10	1.39** [-0.07, 2.67]
Total Impulse (N.kg.s)	85.33 ± 7.18	86.53 ± 4.55	0.79	-0.20 [-9.97, 7.57]
Countermovement Jump				
PV ($m.s^{-1}$)	2.74 ± 0.12	2.63 ± 0.17	0.34	0.75 [-0.10, 0.32]
PF ($N.kg^{-1}$)	22.74 ± 1.70	23.61± 2.5	0.58	-0.41 [-3.99, 2.25]
PP ($W.Kg^{-1}$)	50.08 ± 4.51	49.47 ± 6.24	0.88	0.11 [-7.33, 8.55]
Jump Height (m)	0.35 ± 0.02	0.36 ± 0.05	0.79	-0.26 [-0.07, 0.05]
Squat Jump				
PV ($m.s^{-1}$)	2.89 ± 0.2	2.58 ± 0.16	0.04*	1.71** [0.05, 0.57]
PF ($N.kg^{-1}$)	27.22 ± 5.07	25.03 ± 3.58	0.50	0.50 [-4.21, 8.59]
PP ($W.Kg^{-1}$)	56.87 ± 6.22	52.84 ± 8.08	0.45	0.56 [-6.49, 14.55]
Jump Height (m)	0.36 ± 0.03	0.31 ± 0.07	0.26	0.93 [-0.03, 0.13]

Values are expressed as mean ± SD.

IPF = isometric peak force; mRFD = maximum rate of force development; I100 = impulse 100 ms; I200 = impulse 200 ms; I300 = Impulse 300 ms; PV = peak velocity; PF = peak force; PP = peak power

* Significant difference at $p \leq 0.05$.
** Large magnitude of effect size

DISCUSSION

Findings from the current study indicate that starting players demonstrate significantly greater relative SJ PV ($p \leq 0.05$). Large effect sizes were found for age, relative I100, relative I200, relative I300 and SJ PV and moderate effect sizes were found for CMJ PV and SJ jump height. There was no significant difference in force production for the two groups during the study for any of the tests. The greater relative impulses and mRFD exhibited by the starting group shows that starters generate force faster than bench players which may lead to faster execution of skills on court. The findings of this study are similar to previous research indicating that elite athletes exhibited greater RFD and impulses than less experienced athletes (9).

A limitation in this study may be the small subject pool and age range of the subjects who participated in this research. Future research should focus on investigating the determining factors that can improve performance on these variables.

CONCLUSIONS

According to the results of this study strength and conditioning coaches should aim to maximise impulse and RFD by designing programs which incorporate explosive weighted and un-weighted exercises e.g. plyometric and Olympic lifts (7, 8). In addition, the testing of RFD and impulses as part of an informed physiological testing battery is also advised when working with higher level athletes.

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