

**PHYSIOLOGICAL PROFILE AND VARIABILITY OF JUMP KINETICS IN
NATIONAL LEVEL FEMALE BASKETBALL PLAYERS**

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ABSTRACT

The purpose of this thesis was to investigate the lower body power attributes of elite female basketball players over the course of a competitive season. Minimal research currently exists on female basketball athletes and their physical performance variables such as power, speed, agility and aerobic capacity. Physical characteristics of national level female athletes were then determined, followed by assessing the impact that seasonal load had on key variables of power and movement variability. To date the majority of research on basketball performance variables has focused on the physiological requirements of male basketball players with an assumption that similar qualities are required in female athletes. No prior research has assessed power variables in female basketball athletes over the duration of a competition season or attempted to assess movement variability. Therefore an understanding of power attributes and movement variability of international standard basketball players and how competition seasons influence these capacities is needed. This will allow specialised training of these athletes with reference to season time point and promote enhanced performance outcomes.

A comprehensive literature review was conducted to provide an overview of the peer-reviewed research related to on-court physical performance on women's basketball players. The first finding was that the majority of the physiological markers outlined throughout the literature relating to female players had been conducted on junior players aged between 13 and 15 (40) and college athletes (72) rather than those of an international standard. Improvements in jump performance were described in male junior basketball players when in-season (80) as well as in female collegiate athletes over the course of a 22 week season (52). However in-season training loads and their consequent effect on jump performance in these studies was not reported. It was also noted, that the female collegiate athletes had a poor training base prior to the season commencing and that this most likely contributed to the observed improvements in jump performance across the season (52). Therefore a clear understanding of how training loads and competition could affect jump performance and kinetic variability in the countermovement jump (CMJ) remains unknown. From this review it was evident that further research is required to highlight the specific areas athletes can target in training to improve power production and jump performance.

The first investigative study used twenty six Australian female representative basketball players (24.1 ± 3.6 y; mean \pm SD) categorized as guards (n=9), forwards (n=5) and centres (n=11) to establish physiological and anthropometrical profiles of international level female basketball players. The tests included anthropometric assessment of skinfolds (mm), height (m) and mass (kg), a 20m sprint test, and the Yo-Yo intermittent Recovery Level 1 test.

Countermovement jump (CMJ) data was collected via a Gymaware™ optical encoder and drop jump testing data was collected via a Swift Speed Mat. Physiological differences were evident between the positional playing groups with centres producing significantly ($p > 0.05$) greater concentric peak force (2641 ± 864 N) than guards (2113 ± 134 N) during the CMJ. This was likely due to the significant differences in mass between centres (78.7 ± 7.2 kg) and guards (67.0 ± 6.1 kg). There were small but not clinically significant differences between playing position in CMJ variables for concentric peak power (Watts (W)), concentric peak power (W/kg) and concentric mean power (W) with centres scoring higher than forwards and guards. Guards recorded faster times to 5 m (1.16 ± 0.05 s), than centres (1.22 ± 0.10 s) and forwards (1.17 ± 0.16 s) but again these differences were not clinically significant. Based on the lack of clear physiological and performance differences between the positional groups for these selected variables, it is suggested that these baseline performance markers are required across all positions to be considered for the Australian basketball team.

Following the establishment of baseline performance markers for elite female basketball players, study two aimed to assess the impact of in-season load variation in performance markers in the CMJ in a related group. The total training load was determined using the session-RPE method for each week was calculated as the total load sum of sessional data for each athlete aggregated as a group mean. Junior and senior female representative basketball players (n=10) aged 18 ± 2 y participated in this study. All subjects were post peak height velocity and had a training age greater than 1 year. Countermovement jump (CMJ) data was collected with a Gymaware™ optical encoder at pre-, mid- and post-season time points. Jump performance was maintained across the course of the full season with jump height values of (0.39 ± 0.05 cm) in the pre-season, (0.40 ± 0.07 cm) mid-season, and (0.39 ± 0.06 cm) post-season. Concentric peak velocity, jump height and dip showed the most stability from pre- to post-season with the coefficient of variation (CV%) ranging from 5.6-8.9%. In the period of the highest training load (mid-season), variability of within-subject performance was reduced

in all measures except for jump height, suggesting less variability in the jumps performed. The highest CV% however, occurred for the inter-set scores at mid-season in all measures except eccentric peak velocity, suggesting increased movement variability across the subjects. Therefore seasonal load influenced the range of scores within the group, however, the individuals themselves became more variable at the time point of highest seasonal load. This was evident through altered jump mechanics via increased dip patterns at mid-season. In-season training loads not only impaired jump performance of the basketball players but also altered movement variability.

This thesis profiled the performance markers indicative of international standard female basketball across all the playing positions. There are clear clinically significant ($p > 0.05$) relationships between playing position and anthropometric characteristics, however, no significant differences were evident between performance markers. The ability of players to produce force and velocity efficiently throughout the competition season is considered imperative by basketball coaches and this study found that seasonal loads impaired the improvement of CMJ performance markers but did not to significant decrements in performance. When assessing how the athlete performed the exercise, subjects exhibited increased inter-set movement variability in all variables except eccentric peak velocity when undertaking high in-season training loads, however they were able to maintain jump height. This implies that athletes can utilise numerous NM strategies to achieve the same movement outcomes. This thesis has provided evidence of the physical attributes international standard female basketball players possess. It has also provided a greater understanding of how in-season training loads effect movement variability and jump performance. Further research into women's basketball is needed to assess the strength characteristics of elite players and if this influences on-court performance markers as well as seasonal CMJ performance.

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LIST OF ABBREVIATIONS

BW	Bodyweight
CV	Coefficient of variation
CMJ	Countermovement jump
DJ	Drop jump
EF	External focus of attention
FIBA	International Basketball Federation
IF	Internal focus of attention
LPT	Linear position transducer
NM	Neuromuscular
RFD	Rate of force development
RSI	Reactive strength index
SSC	Stretch shortening cycle
W	Watts

Publications by the Candidate Relevant to the Thesis

Legg J, Williams K, Pyne D, Semple S, and Ball N. Physiological Profile of Australian Elite Female Basketball Players According to Playing Position. *Journal of Australian Strength & Conditioning* In Print, 2017.

Legg J, Pyne D, Semple S, and Ball N. Variability of Jump Kinetics Related to Training Load in Elite Female Basketball. *Journal of Sport Sciences* In Review, 2017.

Conference Presentation by the Candidate Relevant to the Thesis

Legg J, Developing Australian Basketball Players. Japanese Athletic Trainers Association (JATI) International Conference, December 14, 2015, Kyoto, Japan

Legg, J, Strength and Conditioning for Basketball, Basketball Australia Coaches Conference, May 5, 2016, Canberra, Australia.

Legg, J, Developing Australian Female Basketball Players. Southeast Asian Conference on Applied Strength and Conditioning, April 21, 2017, Singapore.