



# Fast Break

Publication for team medical personnel

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ISSUE 11

## WELCOME to FAST BREAK!

Welcome to Fast Break, the official quarterly news bulletin of the FIBA medical commission. Our goal is to introduce our FIBA sport medicine and sport science community to newsworthy research topics and develop a community of practice among physicians and clinicians involved with basketball at every level of play across the globe.

We hope this publication will foster friendly communication and discussion within the basketball world. We welcome and encourage your questions, comments, suggestions, and contribution to this publication.

## MESSAGE FROM THE FIBA MEDICAL COMMISSION

Supporting female athlete health: Over recent years women's sport has exploded with subsequent greater recognition and financial rewards. This is very welcome. Alongside this growth has been a recognition of the unique health issues women athletes face – chest trauma, menstruation issues, fertility, hormonal conditions, and specific nutritional demands, to name a few. The sports medicine research effort has taken a back flip to resolve this oversight. This is very encouraging but will require a focused effort for many years to cover off the deficiencies in our understanding of the unique issues' women basketball players face.

This edition of Fastbreak hopefully brings team physicians working in women's basketball up to date with our current knowledge and where the future research is heading. I also hope it encourages team physicians to be open to approaches from women's health researchers and to facilitate engagement and involvement of their players in this research.

There is a lot of work to be done and we have only started in a very long journey!

Dr Peter Harcourt

Chair, FIBA Medical Commission

## MESSAGE FROM THE EDITOR

As the editor of the Fast Break, I strive to present a newsletter with a literature review that is inclusive of the able-bodied and adaptive games, male and female sport as well as considering developmental to professional levels of play. I envision a publication that is participatory and collaborative among the international basketball community – but we are not there yet. Perhaps something more provocative is needed to jump-start your contribution to this work?

What is more provocative than suggesting 3x3 and men's teams win at basketball because of luck and women win because of skill?

The first selected publication of interest presented in this edition of the Fast Break has attempted to define luck and skill in basketball competition. Fewer surprise outcomes are demonstrated in the women's game than the men's game because competition is less balanced in the women's 3x3 and 5v5 game. This paper is the springboard for this thematic issue of the Fast Break focusing on research into female issues in basketball. I hope that this will foster your ideas for discussion and contributions to the future editions of the Fast Break.

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## IN THIS ISSUE

Selected Publications of Interest

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## SELECTED PUBLICATIONS OF INTEREST

### **How Much Is Winning a Matter of Luck? A Comparison of 3 x 3 and 5v5 Basketball**

Csurilla G, Boros Z, Furesz DI, Gyimesi A, Raab M, Sterbenz T

International Journal of Environmental Research & Public Health, 20(4), 2023 Feb 07.

**BACKGROUND:** The comparison of team sports based on luck has a long tradition and remains unsolved. A contrast between the new Olympic format three-on-three (3 x 3) and five-on-five (5v5) forms of basketball has never been analyzed and provides a comparison within the same form of sports.

**METHODS:** We developed a new method to calculate performance indicators for each team and invented the Relative Score Difference Index, a new competitive balance indicator that allows the comparison of luck in the two basketball forms for both men and women. We collected game-level data about 3 x 3 and 5v5 from the World Cups held between 2010 and 2019 ( $N = 666$ ). Luck was defined as the difference between the expected and the actual outcomes of games. Using the basketball World Cup data, we applied the Surprise Index, ran probit regression models, and compared the basketball forms on the goodness-of-fit of the models.

**RESULTS:** As we predicted, there are differential effects of luck between game formats and sex, such that the 3 x 3 form depends more on luck and women's games are less influenced by luck when compared to men's games.

**CONCLUSION:** Coaches may better understand the differences between the two forms and sexes regarding luck if they are aware that the 3 x 3 and men's competitions are usually more influenced by luck. The findings provide a leverage point for testing new performances and competition balance indicators and will acknowledge the number of games we enjoy watching.

### **Monitoring Internal Load in Women's Basketball via Subjective and Device-Based Methods: A Systematic Review.**

Espasa-Labrador J, Fort-Vanmeerhaeghe A, Montalvo AM, Carrasco-Marginet M, Iruña A, Calleja-Gonzalez J. *Sensors*, 23(9), 2023 May 02.

<https://doi.org/10.3390/s23094447>

The monitoring of internal load in basketball can be used to understand the effects and potential physiological adaptations caused by external load. The main aim of this systematic review was to identify the methods and variables used to quantify internal load in female basketball. The studies included different populations and events: youth athletes, elite, and amateur players. Subjective methods included using the rating of perceived exertion (RPE) method, and sensor-based methods included monitoring the cardiac response to exercise, using heart rate (HR) as the primary metric. The results showed that the HRAvg exhibited a wider range of values during training than during competition, and different metrics were used to evaluate internal load, such as HRMax, HRmin, %HRMax, total time and % of time spent in different HR zones (2-8 zones), Banister's TRIMP, and summated HR zones. RPE and HR metrics were the most commonly used methods. However, the use of multiple metrics with little standardization resulted in significant heterogeneity among studies, limiting meaningful comparisons. The review provides a reference for current research on female basketball. Future research could address this limitation by adopting more consistent measurement protocols standardizing the use of metrics.

## **Influence of Menstrual Cycle on Internal and External Load in Professional Women Basketball Players.**

Arenas-Pareja, María de los Ángeles; López-Sierra, Pablo; Ibáñez, Sergio J.; García-Rubio, Javier.

Healthcare (2227-9032), Mar2023; 11(6): 822.

**ABSTRACT.** The menstrual cycle can be seen as a potential determinant of performance. This study aims to analyze the influence of the menstrual cycle in women on sports performance, more specifically on the internal and external load of professional women basketball players. The sample consisted of 16 women players and 14 training sessions were recorded. A descriptive analysis of the mean and standard deviation of the variables according to the different phases of the menstrual cycle was performed, as well as an ANCOVA, partial Eta<sup>2</sup> effect size criteria, and Bonferroni's Post Hoc test to identify differences among phases. The results establish that ovulation is the phase in which higher values of external load are recorded and, therefore, the late follicular phase is the time of the cycle where a greater intensity in explosive distance, accelerations and decelerations are recorded. Considering women's hormonal cycles, understanding their function and the individual characteristics of each athlete is essential since it allows for the development of specific training, the prevention of injuries and therefore positively affects the performance of women players. To this end, individual training profiles should be created in specific contexts, not following general rules. In addition, psychological factors and the specific position of the athletes should be monitored.

## **Epidemiology With Video Analysis of Knee Injuries in the Women's National Basketball Association.**

Axelrod, Kobi; Canastra, Neal; Lemme, Nicholas J.; Testa, Edward J.; Owens, Brett D. Orthopaedic Journal of Sports Medicine, Sep2022; 10(9): 1-6.

**ABSTRACT:** Background: Knee injuries are the most common type of injury seen in the Women's National Basketball Association (WNBA). However, there are sparse epidemiologic data regarding these injuries over the past 20 years. Purpose/Hypothesis: The purpose of this study was to determine the prevalence, return to play (RTP) rate/length, and mechanism of knee injuries in the WNBA. We hypothesized that anterior cruciate ligament (ACL) tears would have the highest prevalence and longest RTP times. Study DESIGN: Descriptive epidemiology study. Methods: Publicly available WNBA injury reports were used to find WNBA athletes who sustained knee injuries. The RTP length was determined by calculating the number of days between the date of the injury and the date of the first game they played after returning. The RTP rate was determined by calculating the number of players who returned to play from each injury compared with the total number of each injury. Incidence of knee injuries, frequency, and time to RTP were calculated for each injury. Available videos were analyzed to determine the mechanism and body position at the time of injury. Results: Overall, 99 WNBA players were identified as having sustained a knee injury during the study period resulting in loss of play. ACL tears (n = 37; 37%) were the most devastating injury, resulting in the longest time before RTP (n = 375 days; 70%). The position with the highest incidence of knee injuries was guard, accounting for 53% of knee injuries. Video analysis conducted on 12 knee injuries revealed that such injuries were most commonly noncontact (83%). The mechanisms of injury were most commonly planting (58%) and landing from a jump (33%) with the knee flexed in the valgus position (100%). CONCLUSION:

Study findings indicated that ACL tears are the most common clinically significant knee injuries sustained in the WNBA, accounting for 37% of total knee injuries with a mean RTP rate of 375 days. The most common mechanism of injury was planting the foot or landing from a jump with a flexed knee in the valgus position. Knee injuries had a high RTP rate in WNBA players but resulted in them missing a significant amount of playing time.

**Single-leg medial drop landing with trunk lean includes improper body mechanics related to anterior cruciate ligament injury risk: A comparison of body mechanics between successful trials and failed trials in the drop landing test among female basketball athletes.**

Nishino K, Suzuki H, Tanaka M, Kikumoto T, Omori G.

Clinical Biomechanics. 104:105942, 2023 Apr.

**BACKGROUND:** Improper body mechanics during landing is a typical risk factor of anterior cruciate ligament injury. Drop landing test is used to evaluate landing mechanics by observing not only successful trials but also failed trials. Leaning of the trunk, which is frequently observed during failed trials, may lead to improper body mechanics related to anterior cruciate ligament injury. This study aimed to elucidate the mechanisms of landing with trunk lean that may underlie the risks of anterior cruciate ligament injury by comparing body mechanics between failed and successful trials.

**METHODS:** Participants were 72 female basketball athletes. The athletic task was single-leg medial drop landing, and the body mechanics was recorded by a motion capture system and force plate. Participants fixed the landing pose for  $\geq 3$  s in successful trials but failed to do so in failed trials.

**FINDINGS:** Failed trials included the large lean of trunk. There were significant changes in thoracic and pelvic leans at initial contact in failed trials with medial trunk lean ( $p < 0.05$ ). Kinematics and kinetics during the landing phase in failed trials were associated with the risks of anterior cruciate ligament injury.

**INTERPRETATION:** These findings suggest that landing mechanics with trunk lean involves many biomechanical factors related to anterior cruciate ligament injury and demonstrates the inappropriate pose of trunk from the dropping phase. Exercise programs aimed at the landing manoeuvre without trunk lean may contribute to reduce the risks of anterior cruciate ligament injury in female basketball athletes.

## Effects of an Injury Prevention Program on Anterior Cruciate Ligament Injury Risk Factors in Adolescent Females at Different Stages of Maturation.

Reiko Otsuki; Daniel Benoit; Norikazu Hirose; Toru Fukubayashi

Journal of Sports Science & Medicine, Jun2021; 20(2): 365-372.

**ABSTRACT:** The ideal timing to implement anterior cruciate ligament injury prevention programs with respect to maturation is unclear. The purpose of this study was to investigate the effects of an injury prevention program on knee mechanics in early-, late-and postpubertal females. In the study, 178 adolescent female basketball players were assigned to six groups: early pubertal training, early-pubertal control, late-pubertal training, and late-pubertal control, post-pubertal training, and post-pubertal control. The training groups performed an injury prevention program for six months. Medial knee displacement, knee flexion range of motion, and the probability of high knee abduction moment were assessed before and after the training period. After the six-month training period, medial knee displacement was significantly increased in the early-pubertal control group whereas it was unchanged in the early-pubertal training group. Knee flexion range of motion was significantly decreased in the early-pubertal control group whereas it did not change in the early-pubertal training group. The probability of high knee abduction moment was increased in the early-pubertal control group whereas it was unchanged in the early-pubertal training group. The probability of high knee abduction moment was also decreased in the post-pubertal training group whereas it did not change in the post-pubertal control group. The program limited the development of high-risk movement patterns associated with maturation in early puberty while improving the knee mechanics in post-pubertal adolescents. Therefore, an injury prevention program should be initiated in early puberty and continue through the post-puberty years.

## Dynamic balance and explosive strength appear to better explain single leg hop test results among young elite female basketball athletes.

Dominguez-Navarro F, Casana J, Perez-Dominguez B, Ricart-Luna B, Cotoli-Suarez P, Calatayud J.

Scientific Reports, 13(1):5476, 2023 04 04.

To analyze the impact of balance, lower-limb explosive strength and anthropometric variables on the result of the hop test in young elite female basketball athletes. Ninety young elite female basketball athletes (13-17 years), without current or recent lower-limb injury, were assessed in the off-season period of July 2021. Single leg hop test, countermovement jump, Y balance test and anthropometric outcomes were assessed. A correlation study and a regression model were performed to investigate the influence of such outcomes and the value of their participation on the hop test results. It was found a low-to-moderate correlation effect size for both countermovement jump (distance and power flight) and Y balance test values (except interlimb outcomes) with the single leg hop test results. Anthropometric outcomes did not show significant correlation ( $p > 0.05$ ). Regression model revealed that for right hop test, countermovement jump values exhibited an adjusted determination coefficient of 0.408, ( $\beta = 0.249$ ,  $p = 0.013$ ), For left hop test, again the countermovement jump values ( $\beta = 0.229$ ,  $p = 0.025$ ), and left Y balance test values ( $\beta = 0.331$ ,  $p = 0.011$ ) jointly obtained an adjusted determination coefficient of 0.263 significant predictive value for countermovement jump outcomes in both right ( $\beta = 0.249$ ,  $p = 0.013$ ;  $\beta = 0.301$ ;  $p = 0.031$ ) and left leg ( $\beta = 0.229$ ,  $p = 0.025$ ;  $\beta =$

0.365,  $p = 0.040$ ), as well as certain Y balance outcomes values. Explosive strength, and dynamic balance although to a lesser extent, appear to be the most relevant physical-functional factors influencing the single leg hop test results among young elite female basketball athletes. These findings may serve as a basis to implement targeted interventions, such as plyometric and balance training, for an enhancement on functional rehabilitation and reducing the risk of injury related to the hop test results.

### **Study on the correlation between basketball players' multiple-object tracking ability and sports decision-making.**

Gou Q, Li S.

PLoS ONE, 18(4):e0283965, 2023.

**BACKGROUND:** Players' multiple-object tracking (MOT) ability is very important in basketball because it may affect players' sports decision-making (SDM), thus affecting the results of the game. The purpose of this study was to investigate the differences between expert and novice basketball players in MOT ability and SDM and to explore the correlation between basketball players' visual attention and SDM.

**METHODS:** A total of 48 female basketball players (24 categorized in the expert group and 24 in the novice group) participated in the MOT task in Experiment 1 and the basketball 3 vs. 3 games in Experiment 2. Experiment 1 examined the difference in dynamic visual attention characteristics between expert players and novice players by changing the tracking number. Experiment 2 examined the differences between expert players and novice players through the SDM of basketball 3 vs. 3 games. Sports decisions were evaluated by basketball experts. MOT ability and SDM ability were analyzed through Pearson correlation.

**RESULTS:** The overall MOT accuracy of expert players (64.6%) and novice players (55.7%) was significantly different ( $\chi^2 = 59.693$ ,  $P = 0.000$ ). There was no significant difference in accuracy when tracking 2-3 targets ( $P > 0.05$ ), but there was a significant difference in accuracy when tracking 4-6 targets ( $P < 0.05$ ). The overall SDM accuracy of expert players (91.6%) and novice players (84.5%) was significantly different ( $\chi^2 = 31.975$ ,  $P = 0.000$ ). There was no significant difference between expert players and novice players in the accuracy of dribbling decision-making ( $P > 0.05$ ), but there was a significant difference in the accuracy of passing decision-making and shooting decision-making ( $P < 0.01$ ). When tracking 4-5 targets, the tracking score was positively correlated with the passing decision score and dribbling decision score of expert players, and the tracking score of novice players was positively correlated with the passing decision score ( $r > 0.6$ ,  $P < 0.01$ ).

**CONCLUSIONS:** First, the tracking accuracy of expert players was significantly higher than that of novice players, especially when tracking 4-6 targets. As the number of targets increased, accuracy decreased. Second, the accuracy of expert players' SDM was significantly higher than that of novice players, especially in passing decision-making and shooting decision-making. Expert players exhibited fast and accurate SDM. Third, there was a correlation between MOT ability and SDM performance. The MOT ability of 4-5 targets was positively correlated with passing decision-making, which was statistically significant. The correlation between the MOT ability and SDM performance of expert players was greater and more significant. Having too many targets to track (more than 6) interfered with players' decisions.



## Physical Demands of Elite Male and Female 3 x 3 International Basketball Matches.

Feroli D, Conte D, Rucco D, Alcaraz PE, Vaquera A, Romagnoli M, Rampinini E

Journal of Strength & Conditioning Research. 37(4):e289-e296, 2023 Apr 01.

**ABSTRACT:** Feroli, D, Conte, D, Rucco, D, Alcaraz, PE, Vaquera, A, Romagnoli, M, and Rampinini, E. Physical demands of elite male and female 3x3 international basketball matches. J Strength Cond Res 37(4): e289-e296, 2023-This study aimed to (1) characterize the physical demands of 3 x 3 basketball games during live playing time and ball possession and (2) assess the differences in physical demands between male and female players. Following an observational design, video footage from 27 games of the International Basketball Federation 3 x 3 World Cup 2019 were analyzed from 104 international 3 x 3 basketball players ( n = 52 male and n = 52 female players) resulting in a total of 216 (104 male and 112 female) individual game samples. Manual frame-by-frame time-motion analyses determined the relative frequency (n.min<sup>-1</sup>) and duration (%) for several physical demands at different intensities, according to sex, during the live playing time and in ball possession phases. Linear mixed models for repeated measures and effect size (ES) analyses revealed small non-significant differences in the intermittent profile of 3 x 3 basketball games according to sex (total movements per minute, male = 39.3 (38.6-40.1); female = 40.2 (39.5-41.0), estimated marginal means with 95% confidence intervals). Female competitions had significantly greater number of low-intensity activities (LIA, small ES) and high-intensity activities (HIA, small ES) performed per minute over longer games ( small ES), whereas male players had more recovery activities ( small ES). During ball possession, male players spent a larger amount of time performing LIA ( small ES) than female players, who displayed both the greatest number of HIA and the highest percentage of playing time performed at high intensity ( small ES). Overall, these findings suggest that basketball coaches should design sex-specific training sessions based on the specific match demands.

## Sleep Patterns Fluctuate Following Training and Games across the Season in a Semi-Professional, Female Basketball Team.

Power, C.J.; Scanlan, A.T.; Fox, J.L.; Teramoto, M. Brain Sciences

February 2023, 13(2) DOI: 10.3390/brainsci13020238

**Abstract:** Quantifying athlete sleep patterns may inform development of optimal training schedules and sleep strategies, considering the competitive challenges faced across the season. Therefore, this study comprehensively quantified the sleep patterns of a female basketball team and examined variations in sleep between nights. Seven semi-professional, female basketball players had their sleep monitored using wrist-worn activity monitors and perceptual ratings during a 13-week in-season. Sleep variables were compared between different nights (control nights, training nights, training nights before games, nights before games, non-congested game nights, and congested game nights), using generalized linear mixed models, as well as Cohen's d and odds ratios as effect sizes. Players experienced less sleep on training nights before games compared to control nights, training nights, nights before games, and congested game nights ( $p < 0.05$ ,  $d = 0.43-0.69$ ). Players also exhibited later sleep onset times on non-congested game nights compared to control nights ( $p = 0.01$ ,  $d = 0.68$ ), and earlier sleep offset times following training nights before games compared to all other nights ( $p < 0.01$ ,  $d = 0.74-0.79$ ). Moreover, the odds of players attaining better perceived sleep quality was 88% lower on congested game nights than on nights before games ( $p < 0.001$ ). While players in this study attained an adequate

sleep duration (7.3 +/- 0.3 h) and efficiency (85 +/- 2%) on average across the in-season, they were susceptible to poor sleep on training nights before games and following games. Although limited to a team-based case series design, these findings suggest basketball coaches may need to reconsider scheduling team-based, on-court training sessions on nights prior to games and consider implementing suitable psychological and recovery strategies around games to optimize player sleep.

### **The Association Between Functional Movement Screen Scores and Knee Valgus Moments During Unplanned Sidestep Cutting in Netball.**

Boey, Desmond; Lee, Marcus

International Journal of Sports Physical Therapy, 2023; 18(1): 113-121.

**ABSTRACT:** Regular employment of three-dimensional (3D) motion analyses to assess and monitor knee valgus moments; a contributor to non-contact anterior cruciate ligament (ACL) injury; during unplanned sidestep cutting (USC) is costly and time-consuming. An alternative quick-to-administer assessment tool to infer an athlete's risk for this injury could allow prompt and targeted interventions to mitigate this risk. Purpose This study investigated whether peak knee valgus moments (KVM) during weight-acceptance phase of an unplanned sidestep cut were correlated with composite and component scores of the Functional Movement Screen (FMS™). Study Design Cross-sectional, Correlation Methods Thirteen female national-level netballers performed six movements of the FMS™ protocol and three trials of USC. A 3D motion analysis system captured lower limb kinetics and kinematics of each participant's non-dominant leg during USC. Averages of peak KVM across USC trials were calculated and examined for correlations with composite and component scores of the FMS™. Results No correlations were found between FMS™ composite or any of its component scores with peak KVM during USC. Conclusions The current FMS™ did not show any correlations with peak KVM during USC on the non-dominant leg. This suggests that the FMS™ has limited utility in screening for non-contact ACL injury risks during USC

### **Transcranial direct current stimulation during a prolonged cognitive task: the effect on cognitive and shooting performances in professional female basketball players.**

Moreira, Alexandre; Moscaleski, Luciane; Machado, Daniel Gomes da Silva; Bikson, Marom; Unal, Gozde; Bradley, Paul S.; Cevada, Thais; Silva, Fabiana Tenório Gomes da; Baptista, Abrahão F.; Morya, Edgard; Okano, Alexandre Hideki.

Ergonomics; 66(4): 492-505, April 2023.

**ABSTRACT:** The negative effect of prolonged cognitive demands on psychomotor skills in athletes has been demonstrated. Transcranial direct current stimulation (tDCS) could be used to mitigate this effect. This study examined the effects of tDCS over the left dorsolateral prefrontal cortex (DLPFC) during a 30-min inhibitory Stroop task on cognitive and shooting performances of professional female basketball players. Following a randomised, double-blinded, sham-controlled, cross-over design, players were assigned to receive anodal tDCS (a-tDCS, 2 mA for 20 min) or sham-tDCS in two different sessions. Data from 8 players were retained for analysis.

Response Time decreased significantly over time ( $p < 0.001$ ; partial  $\eta^2 = 0.44$ ; no effect of condition, or condition vs. time interaction). No difference in mean accuracy and shooting performance was observed between tDCS conditions. The results suggest that a-tDCS exert no additional benefits in reducing the negative effects of prolonged cognitive demands on technical performance compared to sham (placebo).

Practitioner summary: Prolonged cognitive demands can negatively affect the athletes' performance. We tested whether transcranial direct current stimulation (tDCS) over the left dorsolateral prefrontal cortex (DLPFC) could attenuate these effects on cognitive and shooting performance in professional female basketball players. However, tDCS did not exert any additional benefits compared to sham.

### **Initial Maximum Push-Rim Propulsion and Sprint Performance in Elite Women's Wheelchair Basketball: Differences Between Players' Functional Classification.**

García-Fresneda, Adrián; Carmona, Gerard; Yanci, Javier; Iturricastillo, Aitor International Journal of Sports Physiology & Performance, Aug2022; 17(8): 1187-1195.

ABSTRACT: The aim of the present study was to determine, for the first time in elite women's wheelchair basketball, the differences in the initial maximum push-rim propulsion (IMPRP), mechanical outputs, and sprint performance between A category ( $\leq 2.5$  class) and B category ( $\geq 3$  class) players. A secondary aim was to assess the association between IMPRP mechanical outputs and sprint performance to determine the influence of specific strength in the latter. Sixteen Spanish women's wheelchair basketball players participated in this study: A category ( $n = 9$ , International Wheelchair Basketball Federation [IWBF] classification range: 1–2.5 points) and B category ( $n = 7$ , IWBF classification range: 3–4.5 points). All the players undertook 2 tests: the IMPRP test to measure the strength variables and the 3-, 5-, and 12-m sprint test. B category players reported significantly better performance values in almost all the IMPRP variables and all the sprint distances than A category players. Large to very large significant correlations were observed among IMPRP absolute mechanical outputs (excepting mean power) and sprint performance (3, 5, and 12 m) for all the participants. When the group was divided according to categories A and B, the significant differences observed in the whole group decreased in both groups, although some relationships were large or very large. The IMPRP test and sprint test (3, 5, and 12 m) seemed to be sensitive to differentiate the level between the 2 functional categories. In addition, there was a high association between strength and sprint variables, which shows that greater strength could improve sprint capacity.

### **Relationships Between Different Internal and External Training Load Variables and Elite International Women's Basketball Performance.**

Coyne, Joseph O.C.; Coutts, Aaron J.; Newton, Robert U.; Gregory Haff, G.

International Journal of Sports Physiology & Performance, Jun2021; 16(6): 871-880.

ABSTRACT: Purpose: To investigate the relationships between internal and external training load (TL) metrics with elite international women's basketball performance. Methods: Sessional ratings of perceived exertion, PlayerLoad™/minute, and training duration were collected from 13 elite international-level female basketball athletes (age 29.0 [3.7] y, stature 186.0 [9.8] cm, body mass 77.9 [11.6] kg) during the 18 weeks prior to the International Basketball Federation Olympic

qualifying event for the 2016 Rio Olympic Games. Training stress balance, differential load, and the training efficiency index were calculated with 3 different smoothing methods. These TL metrics and their change in the last 21 days prior to competition were examined for their relationship to competition performance as coach ratings of performance. Results: For a number of TL variables, there were consistent significant small to moderate correlations with performance and significant small to large differences between successful and unsuccessful performances. However, these differences were only evident for external TL when using exponentially weighted moving averages to calculate TL. The variable that seemed most sensitive to performance was the change in training efficiency index in the last 21 days prior to competition (performance  $r = .47-.56$ ,  $P < .001$  and difference between successful and unsuccessful performance  $P < .001$ ,  $f^2 = 0.305-0.431$ ). Conclusions: Internal and external TL variables were correlated with performance and distinguished between successful and unsuccessful performances among the same players during international women's basketball games. Manipulating TL in the last 3 weeks prior to competition may be worthwhile for basketball players' performance, especially in internal TL.

### **The 30-15 Intermittent Fitness Test: A Reliable, Valid, and Useful Tool to Assess Aerobic Capacity in Female Basketball Players.**

Jeličić, Mario; Ivančev, Vladimir; Čular, Dražen; Čović, Nedim; Stojanović, Emilija; Scanlan, Aaron T.; Milanović, Zoran.

Research Quarterly for Exercise & Sport. Mar2020, Vol. 91 Issue 1, p83-91.

**PURPOSE:** The purpose of this study was to determine the reliability, validity, and usefulness of 30-15 Intermittent Fitness Test (30-15IFT) in female basketball players. **Methods:** Nineteen female basketball players ( $17.82 \pm 1.94$  yr,  $175.4 \pm 7.3$  cm,  $67.9 \pm 7.7$  kg) competing in the National Croatian League performed one trial of a continuous treadmill running test and two trials of the 30-15IFT. The 30-15IFT involves 30-s runs across a 40-m course interspersed with 15 s of walking, with running speed increasing every 45 s. The continuous treadmill running test was used as the criterion for validation. **Results:** High to very high reliability across test-retest trials were observed for maximal oxygen uptake ( $VO_{2max}$ ) ( $CV = 4.9\%$ ,  $ICC = 0.85$ ), the 30-15IFT end-running velocity (VIFT) ( $CV = 6.0\%$ ,  $ICC = 0.85$ ), and maximal heart rate ( $HR_{max}$ ) ( $CV = 4.8\%$ ,  $ICC = 0.96$ ). Criterion validity was supported for the 30-15IFT with strong to very strong relationships with  $VO_{2max}$  ( $r = 0.69$ ), VIFT ( $r = 0.74$ ), and  $HR_{max}$  ( $r = 0.73$ ) attained during the continuous treadmill running test. The typical error (TE) of the 30-15IFT was greater than the smallest worthwhile change for  $VO_{2max}$  ( $1.16 > 0.42$  ml/kg/min), VIFT ( $0.56 > 0.20$  km/h), and  $HR_{max}$  ( $2.15 > 1.89$  bpm) adjudging usefulness of the test as marginal. The TE of 0.56 km/h (90% CI = 0.44-0.77 km/h) demonstrates changes in the performance of one to two stages (0.5-1.0 km/h) are meaningful. **Conclusions:** The 30-15IFT possesses acceptable reliability and validity to assess maximal aerobic fitness capacity in female basketball players. While the usefulness of the 30-15IFT was marginal, meaningful changes in performance consisted of only one to two stages. The present findings support the 30-15IFT as a practical testing option for basketball practitioners to assess fitness capacities in female players.

**LET'S CHAT ABOUT...**

Let us know what is on your mind, what you want to chat about in the next issue of the Fast Break.

Email [medical@FIBA.basketball](mailto:medical@FIBA.basketball)

Unfortunately, it seems no one has had anything on his/her mind, as no one has submitted anything to contribute to this segment of the Fast Break.

But consider this: What makes 100%?

If:

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

is represented as:

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26

Then:

H-A-R-D-W-O-R-K is

$$8+1+18+4+23+15+18+11 = 98\%$$

and

K-N-O-W-L-E-D-G-E IS

$$11+12+15+23+12+5+4+7+5 = 96\%$$

But...

A-T-T-I-T-U-D-E is

$$1+20+20+9+20+21+4+5 = 100\%$$

## FROM THE HISTORY BOOK



team, 1899

Source: Wikipedia

Women's basketball began in 1892 at Smith's College, Massachusetts, when Sarah Berensen taught a modified-rules game to her students to improve their physical health. This was a radical idea as Victorian culture considered women to be frail and a woman's place was in the home. The early uniforms were loose bloomers over stockings, and men were forbidden from watching the games; the attire drew public ridicule. There was concern that women would suffer "nervous fatigue" if the game was too strenuous. Today, basketball is one of the most popular and fastest growing sports for women in the world.

University of California Berkley women's basketball

## SHARE YOUR PHOTOS

Please send us your funny, interesting, or remarkable basketball pictures that we can share with the medical and sport science basketball community.

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[Dr. Rosario Ureña Durán](#) has shared this photo:



### ***Tiffany Mitchell defiende con todo su posesión***

■ Tiffany Mitchell protege con tal ímpetu su posesión del balón ante la férrea defensa de Kiera Rowe durante el partido de la liga australiana femenina de baloncesto (WNBL) entre Melbourne Boomers y Sydney Flames que incluso parece que la jugadora de los Boomers convierte su cabello en un arma protectora.

## **THE STUDENT'S CORNER**

This space is intended for sport science and medical students, residents, and fellows to contribute to our knowledge and conversation.

***Please encourage your students to contribute to the Fast Break on a topic of their choosing related to basketball injury, rehabilitation or sport science. The work published here is reviewed and approved for submission by the student's preceptor.***

Dr. Toqa Afifi is a second year psychiatry resident at Harvard Medical School. She writes about considerations we need to make when female athletes are returning to basketball postpartum.

### **Return to Basketball Postpartum: Empowering Female Athletes to Bounce Back**

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The physical and psychological changes brought about by pregnancy and childbirth may significantly impact a woman's ability to return to basketball postpartum. Understanding the unique challenges and considerations surrounding postpartum return to basketball is essential to optimize outcomes for the athlete and her newborn, as well as the basketball team. The length of the postpartum period is not clearly defined given variability in recovery and length of time to return to play and therefore, physicians should consider each postpartum athlete individually considering her unique reproductive history<sup>1</sup>. During the critical postpartum period, from delivery to 12 months postpartum, female athletes face unique physiological, cognitive, and emotional challenges including increased stress and fatigue, breastfeeding challenges, and persistent medical issues such as physical recovery from aspects of birthing (perineal tears or C-section incisions) along with hormonal and metabolic changes. Furthermore, there is the additional challenge of caring for their infants which is accompanied by changes in sleep, daily routine, family structure and other factors that may impact interpersonal relationships and functioning<sup>2,31</sup>.

### **Relevance to Basketball:**

Media has been notorious at stigmatizing pregnant athletes in contrast to the changing positive societal views on exercise during and post pregnancy<sup>3</sup>. Sheryl Swoopes was a WNBA player with the Houston Comets and a USA national team member who won gold at the Centennial Olympics in Atlanta in 1996. Swoopes was at the top of her game and partnered with Nike to release Air Swoopes, alongside the famous Air Jordan line, when she unexpectedly announced her pregnancy. It was not common at that time for female athletes to become pregnant mid-career. After delivering her child, Swoopes made an astounding effort - with support from her coach and teammates - and she was able to reintegrate herself back into the team a startling six weeks after giving birth<sup>4</sup>.

More recently, at 3 months post-partum and still breast feeding, Kim Gaucher from Canada was faced with a difficult choice between attending the Tokyo 2020 Olympics or staying with her infant daughter to continue breastfeeding. This highlights another challenge our elite female athletes face during their postpartum period. Since family were not allowed to travel to Tokyo for the Olympics because of the COVID-pandemic, Gaucher was repeatedly told that she would not be able to bring her daughter to the Olympics. After multiple appeals, pleas, and scrutiny on social media, Gaucher and the IOC were happy to hear that the Tokyo 2020 Organizing Committee changed their policies at the last minute and allowed children of breastfeeding moms entry to Japan for the Olympics<sup>5</sup>. It is difficult to imagine that this was not already an existing rule however, female athletes, especially mothers, constantly face the challenges of their personal wellness and responsibilities or needs as mothers being placed second to their careers.

### **The IOC Expert Group 2016/2017 Meeting:**

In 2016, the International Olympic Committee (IOC) convened an expert group meeting that reviewed available literature regarding elite pregnant and postpartum athletes. The released statement emphasized the lack of data supporting safe return to sport. Postpartum athletes were shown to have increased rates of injury which was determined to be likely exacerbated by rapid return to sport. There is an increased awareness of elite athletes engaging in sport postpartum which calls for action the need to develop high-quality research and evidence-based policies to allow for safe return to sport postpartum<sup>2,6</sup>.

Here, we will highlight some considerations for women during the postpartum period that are important to anticipate for pregnant elite athletes. We will also cover some common complaints and diseases during the postpartum period and if there are specific treatment recommendations. The current literature does not include research specific to basketball players, so the current literature, recommendations and guidelines refer to athletes in general.



## Postpartum Period Considerations:

### Physiologic adaptations postpartum -

- A study in non-athletes outlined that it takes 2 months postpartum for the augmented cardiac response during pregnancy to subside<sup>7</sup>. This augmented response includes an increased cardiac output, a decreased systemic vascular resistance, and increased heart rate<sup>8</sup>.
- VO<sub>2</sub> max and strength levels measured through 1-RM decrease at 6 weeks postpartum compared to pre-pregnancy levels and are partially restored at 27 weeks postpartum<sup>9</sup>.
- Although no studies were found on timing of return of elite athletes to pre-pregnancy training regimens and competition, one study which included both trained women and elite athletes concluded that a high fitness level may be maintained or increased during pregnancy with appropriate strenuous training regimens<sup>10</sup>.

Exercise and breastfeeding – World Health Organization guidelines advise women to breastfeed for at least 6 months, unless otherwise not recommended due to medical conditions, medications in use that may affect breastfeeding or other contraindications. 84.1% of female competitive runners continue to run during breastfeeding<sup>11</sup>. To date, there are no specific recommendations on exercise intensity and breastfeeding. Moderate exercise during lactation does not affect breast milk production or infant growth as long as the woman has appropriate food and fluid intake including adequate hydration prior to exercise. Breastfeeding may temporarily increase the risk of fractures by inducing a loss of skeletal mineral content and strength as most of the calcium content of the milk is supplied through resorption of the maternal skeleton and not through intestinal calcium absorption<sup>32</sup>. However, if intestinal calcium is insufficient during pregnancy, there may be bone resorption which could be exacerbated by breastfeeding; however, there are no known reports of lactation-related fractures in athletes<sup>12</sup>. Athletes should consider breastfeeding their infants or pumping prior to exercise to reduce the discomfort of engorged breasts during physical activity. Athletes may also consider personally fitted sports bras to provide more comfort compared to standard sport bras<sup>12</sup>.

Return to competitive sport - There is little data on the effect of rapid resumption of activities on adverse outcomes in the postpartum elite athlete. However, given the deconditioning that is expected in postpartum women, it is accepted wisdom to gradually resume exercise. A retrospective study of 40 Norwegian elite athletes showed that 77% continued to compete at the same level after childbirth with 38% initiating jogging within the first 6 weeks postpartum<sup>13</sup>. Another study with 34 Norwegian athletes showed that most athletes returned to sport within 6 weeks postpartum<sup>14</sup>.

The First World Congress in Sports Physical Therapy released a consensus statement in 2016 on the return to sport after injury. The 3-element continuum they used for return to sport after injury could also be applied to return to sport postpartum<sup>15</sup>:

- Return to participation in rehabilitation, training, or sport at a lower level than pre-pregnancy
- Return to sport but not at the previous level of performance which may be satisfactory to some athletes after childbirth
- Gradual return to define sport at the same level or above the pre-pregnancy performance level.

Due to the scant data available and the observed tendency for the athletes to resume high intensity postpartum training sooner rather than later, more research is needed on the most appropriate timing to return to competitive sports postpartum<sup>16</sup>.

Pelvic floor injury postpartum – There are no studies in elite athletes on the relationship between timing to return to strenuous exercise or competitive sports postpartum to maintaining normal pelvic floor function. There is a theoretical risk of developing pelvic floor pathologies when resuming strenuous exercise without complete recovery. In the setting of limited evidence, IOC recommends athletes with complicated deliveries affecting the levator ani muscles (anal sphincter tear, forceps delivery, large baby, etc.) to limit activities that generate increased intra-abdominal pressure or high impact for several months postpartum<sup>12</sup>.

Operative delivery versus vaginal delivery – recovery postpartum and return to sport differs depending on the mode of delivery as described below:

Table 1 - Complications Postpartum secondary to mode of delivery<sup>12</sup>.

Relative Complications Postpartum Based on Mode of Delivery			
Vaginal Delivery	Operative Vaginal Delivery		Cesarean Section
	Vacuum-Assisted	Forceps-Assisted	
More likely to report urinary incontinence postpartum compared to C-sections	Higher prevalence of levator-ani avulsion compared to vacuum delivery	High risk of pelvic organ prolapse and later need for surgery for prolapse compared to vaginal and forceps assisted vaginal delivery	Increased abdominal pain postpartum compared to vaginal birth. Most women experience 5-10 days of pain along the incision site requiring analgesia.
Decreased risk of pelvic organ prolapse and subsequent surgery compared to forceps-assisted vaginal delivery			Increasing longitudinal wound tension and wound pain were relative contraindications to early postpartum exercise <sup>33</sup> .

More To Consider Regarding Cesarean Section Delivery:

-The repair process of abdominal fascia requires 6 weeks to regain 51% - 59% of its original tensile strength and 6-7 months to regain 73% - 93% of its original tensile strength <sup>17</sup>.

-Return to training is recommended for most, although not all, women at 4-6 weeks after surgery.

- Return to play depends on multiple factors such as blood pressure, anemia, fatigue, pain management and wound healing. It is recommended that elite athletes who have undergone C-sections coordinate care with their obstetrician to ensure they are medically fit for exercise.

- Once cleared, gradual return to aerobic and strength training as recommended as tolerated by the athlete. It is important that the athlete understands that even a 15-30 day detraining period may lead to significant muscle atrophy which requires reconditioning over time to regain.

-Elite athletes should be counselled on reducing their level of exercise if they experience pain or other negative symptoms related to the surgical site<sup>12</sup>.

### **Common Postpartum Conditions and Diseases:**

Postpartum Depression (PPD) - PPD is depression occurring within 12 months after giving birth and affects 20% of women<sup>18</sup>; however, there are no studies on its prevalence in elite athletes. PPD is associated with poor quality of life for the mother and their babies and negatively affects parenting behaviors and mother-infant bonding. Women with PPD are twice as likely to develop further episodes of depression outside of the post-partum period. There is low quality evidence recommending physical activity (pre pregnancy, during pregnancy or postpartum) as an intervention to prevent PPD. Treatment of PPD is similar to depression treatment outside of the post-partum period. There is insufficient evidence on the use of exercise to treat PPD and no studies on prevention or treatment of PPD in elite athletes<sup>2,12,16</sup>.

Postpartum weight retention/loss - A retrospective study on Norwegian athletes showed that 81% of athletes (mean: 6.5 years after giving birth) returned to their pre-pregnancy weight compared to only 48% of age-matched controls (mean 8.5 years after giving birth)<sup>19</sup>. There are insufficient studies with low evidence on the effect of physical activity on postpartum weight loss in elite athletes and the general population<sup>16</sup>.

Low back and pelvic girdle pain - 22% of women in the general population with pelvic girdle pain during pregnancy had persistent pain 6 months postpartum<sup>20</sup>. In elite athletes, 12.6% reported that they experienced pelvic girdle pain at 6 weeks postpartum and 9.7% had lower back pain<sup>13</sup>. Although no studies were performed on elite athletes, there is moderate evidence for the positive effect of exercise on low back or pelvic girdle pain postpartum.

Diastasis recti abdominis - Studies have shown that postpartum women with >3.5 cm palpated inter-rectus distance had decreased abdominal strength until 6 months postpartum after which there is no correlation between inter-rectus distance and abdominal strength<sup>21</sup>. Due to lack of evidence, there is no consensus on the appropriate exercises to treat diastasis recti abdominis postpartum. There is insufficient evidence on the effect of surgery in treating diastasis recti abdominis<sup>12</sup>.

Pelvic Floor Disorders - A retrospective study on 40 elite athletes showed the prevalence rate of stress incontinence was 29% at 6 weeks postpartum and increased to 35% at the time of completing the study questionnaire. There was no difference between prevalence of stress incontinence in elite athletes compared with a matched control group with at a mean of 7.5 years post-delivery<sup>13</sup>. There is low evidence that pelvic floor muscle training may prevent urinary incontinence postpartum. Despite there being no studies performed on elite athletes, it is recommended that a postpartum athlete with urinary incontinence or pelvic organ prolapse be sent for pelvic floor muscle training and pessary use if indicated<sup>12</sup>.

Pelvic Floor Pain - There is confounding terminology and etiologies for pelvic pain as well as scant data to guide prevention and treatment. Botulinum Toxin A injections into pelvic floor muscles have been used in the general population for chronic pelvic pain; however, there are no studies evaluating this treatment in elite athletes<sup>12</sup>.

Sexual Dysfunction - Approximately 90% of women are sexually active during pregnancy and 30% are active in the ninth month of pregnancy<sup>22</sup>. Sexual desire may decrease postpartum and improve over the course of the first year postpartum<sup>23</sup>. Women with intact perineums are more likely to resume sexual activity earlier postpartum compared to women with perineal trauma<sup>24</sup>. The most common cause of sexual dysfunction 2-3 months postpartum is sexual pain, with other

causes being desire, arousal, and orgasmic disorders<sup>23</sup>. Risk factors to developing sexual dysfunction postpartum include infrequent sexual activity, delayed initiation of sexual activity postpartum (>9 weeks postpartum), primiparity, postpartum depression, antidepressant use and relationship dissatisfaction<sup>22</sup>. Evidence shows that mode of delivery has no effect on sexual function, except for women's perception of better vaginal tone after cesarean section compared to other modes of delivery<sup>25</sup>. There are no studies on sexual dysfunction postpartum in elite athletes. Treatment of sexual dysfunction includes evaluating type of sexual dysfunction and etiology, assessing healing of vagina and vulva, encouraging time for intimacy and use of vaginal lubricants, and pelvic floor training<sup>12</sup>.

### **Postpartum Return to Play Recommendations Summary:**

Due to scant data, the guidelines listed below are a summary of the IOC recommendations and available literature. Professional guidance, clearance and follow up with the athlete's obstetrician/gynecologist, sport and exercise medicine physician, the medical team and coach are needed at each step until further detailed official guidelines are available:

- 1) Medical clearance: The athlete must obtain medical clearance from a healthcare professional specializing in postpartum care, such as an obstetrician/gynecologist or a Sport and exercise medicine physician. The assessment should confirm that the athlete is physically ready to resume training and competing<sup>29</sup>.
- 2) Establish Baseline: Assess the athlete's current fitness level and establish baseline measurements of strength, endurance, flexibility, and other relevant parameters. This will help track progress and guide the training program.
- 3) Gradual return to exercise: Begin with low impact exercises, such as walking or swimming and gradually increase intensity and duration over several weeks. Focus on rebuilding core strength and addressing any specific postpartum issues, such as diastasis recti or pelvic floor dysfunction<sup>2</sup>.
- 4) Pelvic Floor Rehabilitation: Incorporate pelvic floor exercises, such as Kegels, to strengthen the pelvic floor muscles and address any potential issues related to childbirth. Consider consulting with a pelvic floor physical therapist for guidance<sup>30</sup>.
- 5) Gradual Return to Sport-Specific Training: May follow the return to sport after injury model developed by The First World Congress in Sports Physical Therapy with the guidance of the physician, team, and tolerance of the athlete<sup>15</sup>.
- 6) Monitor Postpartum issues: Continuously monitor and address any postpartum issues, such as postpartum depression, appropriate weight gain/loss postpartum, low back or pelvic girdle pain, pelvic floor pain, diastasis recti, pelvic organ prolapse, urinary and/or stool incontinence, or sexual dysfunction<sup>12</sup>. Modified training is necessary to prevent exacerbation of these issues and seek appropriate medical rehabilitation support<sup>29</sup>.

### **Conclusion:**

In conclusion, there is a concerning lack of research and insufficient data with low evidence on pregnant and postpartum elite athletes and no specific guidelines on return to exercise and competitive sport postpartum. The 2016 IOC expert group meeting highlights the unanswered questions after reviewing the current literature and summarizes them in Part 4 of their evidence summary consensus statement<sup>26</sup>. The British Journal of Sport Medicine published a qualitative study in 2022 on the experiences of elite athletes during pregnancy which emphasized the need for more research and advocacy aimed at empowering female athletes to be prepared prior to pregnancy and to have adequate knowledge, resources, care and support during the pregnancy and postpartum period<sup>28</sup>. There is substantial room for growth and plenty of work that needs to be done to give our postpartum athletes a chance to bounce back into the game.

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