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ORIGINAL

RELATIONSHIP BETWEEN METHODOLOGIES FOR LOAD CONTROL IN PROFESSIONAL BASKETBALL

RELACIÓN ENTRE METODOLOGÍAS DE CONTROL DE LA CARGA EN EL BALONCESTO PROFESIONAL

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ABSTRACT

The aim of this study was to determine the relationship between different load assessment methods in a professional basketball team. Twelve professional basketball players of the same team were subjected to the same training plan design and were monitored daily with heart rate monitors, GPS tools and perceived exertion scales. Results suggested that there were significant differences in training load between all monitoring methods: RPE (x^2=12.4; P=.015), sRPE (x^2=21.5; P<.001), TRIMP (x^2=23.5; P<.001), SHRZ (x^2=19.3;

P<.001) and distance (x^2=21.7; P<.001). Correlations were found between RPE and heart rate but not between these methods and the distance travelled during sessions: Borg (*p*=.19; P=.79), sRPE (*p*=.14; P=.299) and sHR-Z (*p*=.17; P=.197). These results suggested that different load assessment methods render varying results in a professional basketball team. In this sample, perceived exertion rate was suggested as the best method for assessing training load in professional basketball players.

KEYWORDS

Basketball, training load, heart rate, TRIMP, perceived effort

RESUMEN

El objetivo de este trabajo fue determinar la relación existente entre diferentes metodologías de medición de la carga de entrenamiento en un equipo profesional de baloncesto. 12 jugadores de un mismo equipo fueron sometidos a estructuras de entrenamiento iguales en cuanto a diseño y fueron monitorizados diariamente con frecuencia cardiaca, GPS y percepción subjetiva de esfuerzo. Los resultados indicaron diferencias significativas entre todas las metodologías de control utilizadas. RPE (x^2=12.4; P=.015), sRPE (x^2=21.5; P<.001), TRIMP (x^2=23.5; P<.001), SHRZ (x^2=19.3; P<.001) y distancia (x^2=21.7; P<.001). Se observó una correlación entre todas ellas exceptuando la variable distancia recorrida; Borg (*p*=.19; P=.79), sRPE (*p*=.14; P=.299) y sHR-Z (*p*=.17; P=.197). Estos resultados sugieren que los diferentes métodos de evaluación utilizados para el control de la carga de entrenamiento determinan resultados variables en un equipo de baloncesto profesional. Se consideró que el ratio de esfuerzo percibido por sesión resulta el instrumento más eficaz para el control de la carga de entrenamiento.

PALABRAS CLAVE

Baloncesto, carga de entrenamiento, frecuencia cardiaca, percepción de esfuerzo.

1. INTRODUCTION

Basketball is characterized by variable intensities and different movement patterns such as running, jumping, sprinting, throwing or changing directions (Herrán et al., 2017). To achieve maximum sports performance, players are subjected to different levels of training loads (TL) with the intention of generating physiological adaptations that improve their performance and avoid the appearance of injuries (Aoki et al., 2017; Ferioli et al., 2018). The continuous monitoring of the TL will be essential, since it will allow the coach to know the level of accumulated fatigue, facilitating the daily management in their professional work (Gabbett et al., 2017).

The current scientific literature has proposed different methodologies for obtaining objective information that allows quantifying the TL (Mujika, 2017; Reche-Soto et al., 2020). These are classified under two generic criteria for obtaining information in the form of arbitrary training units (UA); external load (${}_{ext}L$) and internal load (${}_{int}L$) (Rojas-Inda, 2018). The ${}_{ext}L$ represents the quantitative description of the physical work developed in a training session expressed from absolute physical variables, such as the distance traveled, the acceleration achieved or the power developed (Gomez-Carmona et al., 2019). On the other hand, the ${}_{int}L$ determines the individual effect that the ${}_{ext}L$ causes at a physiological level in an athlete in a training or competition situation (Garcia-Santos et al., 2019; Moreira et al., 2012). This is determined mainly through the control of variables such as heart rate (Hr), lactate concentration, hormonal concentration or subjective perception of effort (Fox et al., 2018). It should be taken into account that the ${}_{ext}L$ variable describes the training components (volume, intensity, density, rest and duration) in a theoretical way (González-Espinosa et al., 2018), and that despite organizing work under the same criteria, the training effects caused on each player are totally different. Elements such as the player's physical condition, genetics, mental state (motivation) or environmental elements are determining factors in individual adaptive processes (Foster et al., 2001). Unfortunately, to date there is no clear consensus on which is the best methodology for the quantification of TL in team sports, causing ${}_{int}L$ variables to be combined (heart rate, lactate or the Borg scale) with variables of ${}_{ext}L$ (minutes, meters traveled or number of jumps) (Maupin et al., 2020). One of the most accepted options in the current scientific literature is the rate of perceived exertion per session (sRPE), a variable that combines subjective perception of exertion parameters (${}_{int}L$) with the temporal variable minutes of training (${}_{ext}L$) (Haddad et al., 2017; Lupo et al., 2017). The wide acceptance of this method within the scientific community, as well as its low economic cost have made it a fundamental tool in the control of TL in team sport (Bartlett et al., 2017).

Few studies have analyzed the relationship between different methodologies for TL control in professional basketball, especially considering a real competitive context (Berkelmans et al., 2018; Fox et al., 2017; Petway et al., 2020). The knowledge of the differences between the methodological options for the TL control will allow us to make a correct choice as to which methodology is the most appropriate for the quantification. Therefore, the objectives of this study are: to establish the relationship between different TL measurement methodologies within a professional context of basketball players, and to try to determine which is the most appropriate tool for this use.

2. METHODS

2.1. PARTICIPANTS

Twelve professional basketball players belonging to the Spanish first division (ACB) participated in this study. The physical and anthropometric characteristics of the players are shown in Table 1.

Table 1. Physical and anthropometric characteristics of the participants.

	Mean ± SD [Range]
Age (years)	27 ± 5 [20 - 35]
Weight (kg)	96.7 ± 11.1 [75 - 114.3]
Height (cm)	200.2 ± 7.3 [185 - 208]
Body fat (%)	9.44 ± 2.28 [6.3 - 12.4]
Experience (years)	10 ± 5 [2 - 17]
VO_{2max} (ml/kg/min)	53.24 ± 4.25 [49 - 63.18]
VO_{2max} (bpm)	182.9 ± 8 [171 - 197]
VT2 (ml/kg/min)	44.87 ± 2.83 [41.32 - 49.62]
VT2 (bpm)	167.7 ± 5.8 [162 - 182]
VT2 (%VO_{2max})	0.85 ± 0.03 [0.8 - 0.9]
VT1 (ml/kg/min)	37.58 ± 3.6 [30.75 - 43.32]
VT1 (bpm)	147.9 ± 4.9 [140 - 156]
VT1 (% VO_{2max})	0.72 ± 0.05 [0.6 - 0.8]

The inclusion criteria for participation in this study were; (i) to be a professional player with a valid federation record, (ii) to have at least 5 years of professional experience in the practice of basketball (Europe, Spain or USA) and (iii) to have trained fully within the team of participants since the start of the preseason. Those players who joined the team once the preseason or competitive period began were excluded.

Before starting the data collection, the participants and the technical team were informed of the objectives of this work, as well as the benefits and possible risks that could derive from their participation. The study was designed in accordance with the latest version of the Declaration of Helsinki (Fortaleza 2013) and was previously approved by the Aragón Ethics Committee (ref. No. 06/2018). All the players signed the informed consent and completed a medical examination.

2.2. EXPERIMENTAL PROCEDURE

This retrospective descriptive study was carried out between December 3, 2018 and January 6, 2019. One week before the start of data collection, all players went through the biomedical analysis laboratory to complete the general physical assessments. Anthropometric measurements were made following the ISAK protocol. The same researcher (internationally certified, ISAK level 2) recorded the measurements of all participants; summatory of 5 skinfolds in mm (triceps, abdominal, subscapular, mid-thigh and calf) analyzed with a Harpenden® skinfold caliper with a precision of 0.2mm, height (cm) obtained using a SECA© measuring rod with a precision of 1mm and body weight (kg) recorded with a scale with 0.1kg reported precision (SECA© scale). The body mass index (BMI) was obtained from the formula kg/m^2. The participants performed a progressive maximal exercise test using a gas analyzer (CPX/DMed Graphics, St. Paul, MN, USA) (Lucía et al., 2003). The test started with a 3% incline and a running speed of 8km/h. The speed was increased by 0.5 km/h every 30 seconds, performing the exercise until exhaustion. Players were considered to have reached VO_{2max} when; (i) the maximum heart rate

(Hr_{max}) was reached in the test according to the formula = 220 - age, (ii) the respiratory exchange rate defined by the instantaneous proportion of exhaled carbon dioxide (VCO_2) and consumed oxygen (VO_2) reached levels above 1.10 and VO_2 remained in plateau, despite the increase in exercise intensity and (iii) the highest value of VO_2 was reached during 15 seconds. When 2 of these criteria were met simultaneously, VO_{2max} was determined.

2.3. TRAINING LOAD MONITORING VARIABLES

The estimation of the TL was carried out according to five different quantification methods:

• The ratio of perceived exertion or Borg scale (RPE, CR-10 scale) was used as a measure of training intensity (Borg & Löllgen., 2001). A printed Spanish translation of the CR-10 scale was used (Casamichana et al., 2013). The registry was carried out under the established methodological criteria: after the end of each training session (between 5-30 minutes post session) and individually. All the players who participated in the study were previously familiar with the use of this scale.

• sRPE, TL variable proposed by Foster (Foster et al., 2001). It was calculated from the product between the RPE and the number of minutes of training performed.

*sRPE = Borg scale value * min of training*

• Training impulse (TRIMP). Measurement concept proposed by Banister and Calvert (Banister & Calvert., 1980) and adapted by Lucía (Lucía et al., 2003). The total TRIMP value was obtained by taking the player's Hr during the time that he spent within each of the metabolic thresholds; (Phase I or intensity <VT1, phase II between VT1 and VT2 and phase III or maximum intensity> VT2) and multiplying it by the value that the author gives to each level (Phase I = 1, phase II = 2 and phase III = 3). The formula was applied:

Total TRIMP = (min of phase 1 HR x 1) + (min of phase 2 HR x 2) + (min of phase 3 HR x 3)

• Sum of Hr zones (SHRZ). Methodology proposed by Edwars (Edwars., 1993). The TL was quantified by applying the following formula:

SHRZ = (duration in zone 1 x 1) + (duration in zone 2 x 2) + (duration in zone 3 x 3) + (duration in zone 4 x 4) + duration in zone 5 x 5). Each zone mentioned corresponds to: zone 1 = 50% -60%, zone 2 = 60% -70%, zone 3 = 70% -80%, zone 4 = 80% -90% and zone 5 = 90% -100% of the Hr_{max}.

• Meters covered by each player during training.

2.4. PROCEDURES

The participants were monitored during the competitive period between December 3, 2018 and January 6, 2019. A period of the season that had the same work and competition structure was determined: 4 consecutive training days with the same structure sequencing in terms of training sessions; Tuesday and Thursday double session, physical conditioning work in the morning (30 minutes of warm-up and 1 hour of work in the gym) and in the afternoons tactical work and individual technique exercises on the court. Wednesday and Friday same structure as Tuesday and Thursday afternoons.

A total of 20 workouts were analyzed. During the data collection, 5 official matches were played and 48 hours of rest were always left between the match and the next training session. All sessions were planned by the same team of trainers and the same weekly training criteria were met in terms of the exercises distributed on each day of the week.

Hr and meters covered during the training were recorded continuously throughout the 20 sessions. No data was recorded during the competition as the ACB regulations do not allow it. The Polar Team Pro® measurement system (Polar Electro, Finland) with Hr control bands and accelerometry was used to record the data (Pueo et al., 2017). To download and analyze the data, the software provided by the same manufacturer was used. In each training session the following measurements were recorded: (i) Hr_{max} and mean Hr (Hr_{mean}), (ii) minutes elapsed within each defined zone in relation to the% of Hr_{max} (50-60%, 60-70%, 70 -80%, 80-90% and 90-100% of the Hrmax), (iii)% of the Hr within each work zone, (iv) time spent in each metabolic zone defined under individual physiological parameters (below of the aerobic threshold, between the aerobic-anaerobic threshold and above the anaerobic threshold) and (v) meters covered by each player. In addition, the RPE was taken immediately after the completion of each training individually so that the information provided by the player did not influence the value given by another partner.

3. STATISTICAL ANALYSES

To determine the distribution of the data, the Shapiro-Wilk test was used and homoscedasticity was calculated from the Levene test (Field, 2013). Due to the small sample size and the distribution obtained, non-parametric tests were applied. A first descriptive analysis was performed based on the individual weekly average value in relation to mean values, standard deviation (± SD) and the range [min - max]. The variables that did not follow a Gaussian distribution were calculated from the mean and the interquartile range [P25 - P75]. Differences between repeated measurements were checked using the Friedman test (x2). Statistically significant cases were compared in pairs using Wilcoxon's rank sum. Statistical significance was established with the P value <.05. All tests were performed using SPSS 24.0 software (SPSS Inc., Chicago IL, USA).

4. RESULTS

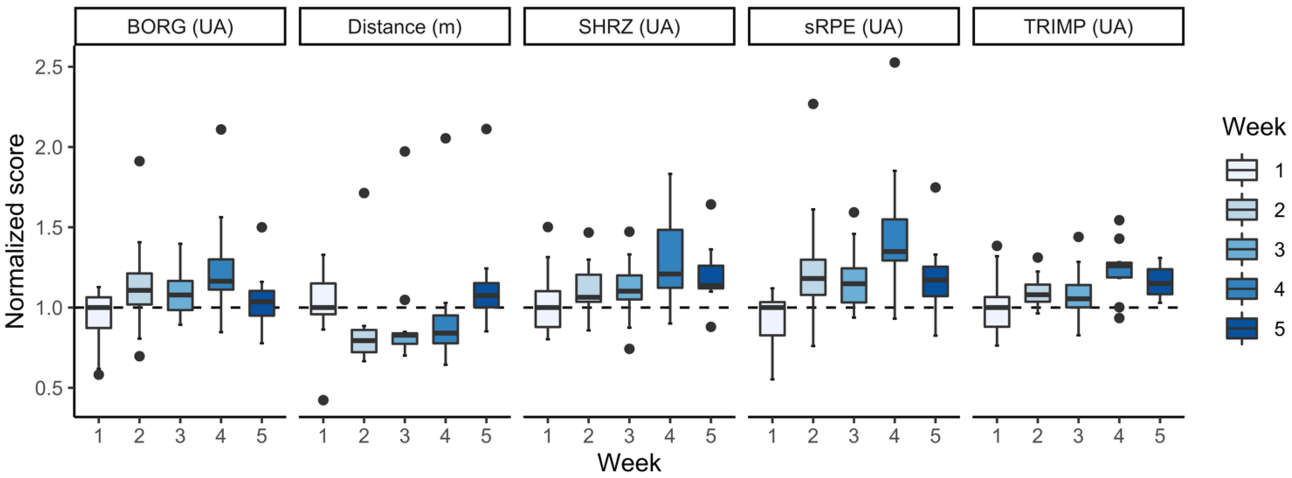
A total of 29 hours and 53 minutes of training were analyzed (26.7% physical training, 52.9% tactical training, and 20.4% technical exercise training). The values expressed as mean and interquartile range of the different weekly TL control methodologies are described in Table 2 and in Figure 1. The results suggest the existence of significant differences between all the measurement methodologies used. [RPE ($x2 = 12.4$; $P = .015$), sRPE ($x2 = 21.5$; $P < .001$), TRIMP ($x2 = 23.5$; $P < .001$), SHRZ ($x2 = 19.3$; $P < .001$) and distance ($x2 = 21.7$; $P < .001$)] despite analyzing identical training sessions in terms of their design.

Table 2. Comparison of repeated means of the individual mean values for the different TL methodologies

	Week 1	Week 2	Week 3	Week 4	Week 5
BORG**	6 [5-6]	6 [5-6]	6 [5-6]	7 [6-7] †*	6 [5-6]*
TRIPM**	108 [95-115]	114 [103-129] †	110 [104-119]	138 [116-147] †*	128 [111-144] †
SRPE **	431 [357-446]	480 [415-516] †	461 [400-504] †	598 [542-607] †*	497 [423-532] †*
SHRZ**	154 [136-170]	181 [157-202]	179 [150-198]	215 [182-246] †	201 [162-224] †
DIST**	14524 [13916-16706]	11576 [10594-12800] †	12272 [11472-14113] †	12753 [12132-13086]	15394 [14767-16552]*

** Main significant differences between measurement methodologies
† Significant differences compared to the first week
• Significant differences compared to the previous week

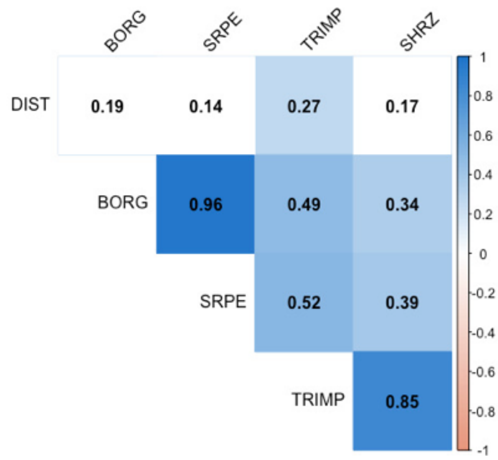
Figure 1. *Evolution of the load indicators during the five weeks of observation.*



(UA) Arbitrary units of measurement for training load control tools.
(m) Meters covered by the player in each work week.

The associations between TL control variables are described in Figure 2. It shows the existence of correlations between all the methodologies analyzed, except for the distance traveled and the Borg scale ($p = .19$; $P = 79$), sRPE ($p = .14$; $P = .299$) and SHRZ ($p = .17$; $P = .197$).

Figure 2. *Spearman correlation coefficient between the different TL methods.*



5. DISCUSSION

To our knowledge, this is the first study that attempts to analyze the relationship between different TL control methodologies in a professional basketball context under the same planning structure throughout the competitive period. The objectives established for this work have been; (i) to establish the existing relationship between different TL measurement methodologies within a professional context of basketball players and (ii) to determine which is the most appropriate option for TL.

The results of our work suggest the existence of significant differences between the methodologies used to control TL, despite analyzing the same training sessions repeated over the same training weeks in terms of their design and structure. In the same way, the existence of correlations between all the methodologies used is observed, except for the variable distance traveled. In relation to this last variable, the results obtained are in line with the results observed in previous studies in which no important correlations were found between the methodologies of $_{ext}L$ and $_{int}L$. Scalan et al. (Scanlan et al., 2014), analyzed a group of 9 semi-professional basketball players during a period of 9 weeks and tried to determine the possible relationship between different load control variables. A weak correlation was observed when interrelating $_{ext}L$ levels (determined using accelerometry techniques), and sRPE (r =.49; P <.001), TRIMP (r = .38; P = .011) and SHRZ (r =.61; P <.001). In the case of our study, we only observed a weak significant correlation between the TRIMP methodology and the meters traveled (p=.27; P <.001), with no significant differences being observed when attempting to correlate the distance traveled with the rest of the variables analyzed.

In contrast, in a recent review by McLaren et al. (McLaren et al., 2018), the existence of a strong association between $_{ext}L$ and $_{int}L$ was determined by relating variables such as meters traveled, distance traveled at different speeds, acceleration and number of impacts with subjective perception of effort and Hr. Unfortunately, although the authors focused their study on team sports, the vast majority of the analyzed studies use sports such as soccer, American football or rugby, where the playing field is much larger than that used in basketball. This intrinsic characteristic of this type of sports will not only increase the distance traveled during each training session, but could also modify the level of self-perception of fatigue due to the duration of the intensity achieved, the metabolic pathways required and the work-time relationship. Also, the recovery could directly influence the level of self-perception of fatigue. These same authors made a clear differentiation between perceptual methods and those that use more integrative variables, concluding that both types of methodologies used in the control of TL could provide different results.

Along the same lines, Scanlan et al. (Scanlan et al., 2016), analyzed 10 weeks of training divided into 3 different blocks depending on the content of the work performed: base training, strength work and court training. A high correlation was observed between the different $_{int}$L methodologies used and the type of work carried out in the training sessions, with the exception of strength training (sRPE-TRIMP: $p = .38$; $P < .005$ and sRPE-SHRZ: $p = 52$; $P < .005$). These values show that not only should the type of metabolic pathway stimulated and the depletion of the substrate deposits used in training be taken into account, but the effects that the type of task posed on the nervous system should also be considered. In our study, the levels of correlation observed between the TRIMP methodology and the SHRZ are similar to those obtained in this study. This finding could be partly due to the fact that during competitive periods the teams follow similar load dynamics and weekly training methodologies with the intention of reaching the weekend game in the best possible conditions. The small differences observed could be attributed to the composition of the analyzed sample, since in the case of our study professional players were analyzed while in the study by Scanlan et al., a sample of semi-professional players was analyzed without specifying the real level of performance. The characteristics of the studied sample could cause differences because the capacity for self-perception of fatigue and the level of physical condition of each study group could be different: professional vs. amateur. The differences observed in our study in relation to TL methodologies make us think about the possibility that the type of content developed (technical, tactical, emotional or physiological) may determine the ideal method to assess TL.

Finally, the results obtained in our study suggest that the methods based on the Hr variable (Hr, TRIMP or SHRZ) provide different information depending on the TL methodology used when analyzing a sport such as basketball with a sample of professional players. Despite the statistical relationships observed between the $_{int}$L and $_{ext}$L methodologies for training control, we opted like other authors (Bartlett et al., 2017; Haddad et al., 2017; Lupo et al., 2017) for the use of perceptual methodologies. The easy of application and the low economic cost of using these tools, together with the strong statistical correlation described in relation to variables such as lactic acid production, metabolic acidosis, catecholamines and endorphins (Scherr et al., 2013), makes it an especially interesting method in sports where explosive force and power factors prevail, such as basketball.

6. STUDY LIMITATIONS

Future studies are necessary in order to clarify which is the best methodology for the control of TL and to be able to describe the type of fatigue produced based on the work content within the collective sport. The interpretation of the data is subject to the small number of participants (n = 11), which may influence the statistical results analyzed. More studies with professional samples of indoor sports are necessary to corroborate our conclusions.

7. CONCLUSIONS

The results of our study suggest that despite an identical design in the exercise structure and planning of training weeks, the individual physiological response of the players in the form of Hr is always different and does not respond to a certain pattern. The existence of various levels of correlation between the methodologies used to control TL in a sport such as basketball allows us to determine that all are valid except for the meters covered by the player during training. Despite this, we opted for self-perceptual methodologies as they present higher levels of correlation between the options used.

8. REFERENCES

Aoki, M. S., Ronda, L. T., Marcelino, P. R., Drago, G., Carling, C., Bradley, P. S., & Moreira, A. (2017). Monitoring training loads in professional basketball players engaged in a periodized training program. *Journal of Strength and Conditioning Research*, *31*(2), 348–358. https://doi.org/10.1519/JSC.0000000000001507

Banister, E. W., & Calvert, T. W. (1980). Planning for Future Performance-Implications for Long Term Training. *Can J Appl Spt Sci*, 5(3), 170-173. https://doi.org/6778623

Bartlett, J. D., O'Connor, F., Pitchford, N., Torres-Ronda, L., & Robertson, S. J. (2017). Relationships between internal and external training load in team-sport athletes: Evidence for an individualized approach. *International Journal of Sports Physiology and Performance*, *12*(2), 230–234. https://doi.org/10.1123/ijspp.2015-0791

Berkelmans, D. M., Dalbo, V. J., Kean, C. O., Milanovic, Z., Stojanovic, E., Stojiljkovic, N., & Scanlan, A. T. (2018). Heart Rate Monitoring in Basketball: Applications, Player Responses, and Practical Recommendations. *Journal of Strength and Conditioning Research*, *32*(8), 2383–2399. https://doi.org/10.1519/JSC.0000000000002194

Borg, G., & Löllgen, H. (2001). *Borg's perceived exertion and pain scales.* Sage: Germany

Casamichana, D., Castellano, J., Calleja-Gonzalez, J., RomaN, J. S., & Castagna, C. (2013). Relationship between indicators of training load in soccer players. *Journal of Strength and Conditioning Research*, *27*(2), 369–374. https://doi.org/10.1519/JSC.0b013e3182548af1

Edwars, S. (1993). *The Heart Rate Monitoring Book. CA: Fleet Press, editor*.

Ferioli, D., Bosio, A., La Torre, A., Carlomagno, D., Connolly, D. R., & Rampinini, E. (2018). Different training loads partially influence physiological response to the preparation period in basketball. *Journal of Strength and Conditioning Research*, *32*(3), 790–797. http://doi: 10.1519/JSC.0000000000001823.

Field, A. (2013). *Discovering statistics using IBM SPSS statistics. Sage: Londres.*

Foster, C., Florhaug, J. A., Franklin, J., Gottschall, L., Hrovatin, L. A., Parker, S., Doleshal, P., & Dodge, C. (2001). A New Approach to Monitoring Exercise Training. *Journal of Strength and Conditioning Research*, 15(1), 109-115. https://doi.org/10.1519/1533-4287

Fox, J. L., Scanlan, A. T., & Stanton, R. (2017). A Review of Player Monitoring Approaches in Basketball: Current Trends and Future Directions. In *Journal of Strength and Conditioning Research*, 31(7), 2021-2019. https://doi.org/10.1519/JSC.0000000000001964

Fox, J. L., Stanton, R., Sargent, C., Wintour, S.-A., & Scanlan, A. T. (2018). The Association Between Training Load and Performance in Team Sports: A Systematic Review. *Sports Medicine (Auckland, N.Z.)*, *48*(12), 2743–2774. https://doi.org/10.1007/s402790180982-5

Gabbett, T. J., Nassis, G. P., Oetter, E., Pretorius, J., Johnston, N., Medina, D., Rodas, G., Myslinski, T., Howells, D., Beard, A., & Ryan, A. (2017). The athlete monitoring cycle: A practical guide to interpreting and applying training monitoring data. *British Journal of Sports Medicine*, *51*(20), 1451–1452. https://doi.org/10.1136/bjsports-2016-097298

Garcia-Santos, D., Pino-Ortega, J., Garcia-Rubio, J., Vaquera, A., & Ibanez, S. J. (2019). Internal and External Demands in Basketball Referees during the U-16 European Women's Championship. *International Journal of Environmental Research and Public Health*, *16*(18). https://doi.org/10.3390/ijerph16183421

Gomez-Carmona, C. D., Pino-Ortega, J., Sanchez-Urena, B., Ibanez, S. J., & Rojas-Valverde, D. (2019). Accelerometry-Based External Load Indicators in Sport: Too Many Options, Same Practical Outcome? *International Journal of Environmental Research and Public Health*, *16*(24). https://doi.org/10.3390/ijerph16245101

González-Espinosa, S., García-Rubio, J., Feu, S.; Ibáñez, S.J. (2020) External Load in Basketball. According To Game Situation and Methodology. *Revista Internacional de Medicina y Ciencias de la Actividad Física y el Deporte*, 20 (79), 395-417.https://doi.org/10.15366/rimcafd2020.79.002

Haddad, M., Stylianides, G., Djaoui, L., Dellal, A., & Chamari, K. (2017). Session-RPE method for training load monitoring: Validity, ecological usefulness, and influencing factors. *Frontiers in Neuroscience*, *11*(2), 1–13. https://doi.org/10.3389/fnins.2017.00612

Herrán, A., Usabiaga, O., & Castellano, J. (2017). Comparación del perfil físico entre 3x3 y 5x5 de baloncesto formativo / Physical Profile Comparison Between 3x3 and 5x5 Basketball Training. *Revista Internacional de Medicina y Ciencias de La Actividad Física y Del Deporte; Núm. 67*(67). https://10.15366/rimcafd2017.67.003

Lucía, A., Hoyos, J., Santalla, A., Earnest, C., & Chicharro, J. L. (2003). Tour de France versus Vuelta a España: Which is harder? *Medicine and Science in Sports and Exercise*, *35*(5), 872–878. https://doi.org/10.1249/01.MSS.0000064999.82036.B4

Lupo, C., Tessitore, A., Gasperi, L., & Gomez, M. A. R. (2017). Session-RPE for quantifying the load of different youth basketball training sessions. *Biology of Sport*, *34*(1), 11–17. https://doi.org/10.5114/biolsport.2017.63381

Maupin, D., Schram, B., Canetti, E., & Orr, R. (2020). The Relationship Between Acute: Chronic Workload Ratios and Injury Risk in Sports: A Systematic Review. *Open Access Journal of Sports Medicine*, *11(1)*, 51–75. https://doi.org/10.2147/OAJSM.S231405

McLaren, S. J., Macpherson, T. W., Coutts, A. J., Hurst, C., Spears, I. R., & Weston, M. (2018). The Relationships Between Internal and External Measures of Training Load and Intensity in Team Sports: A Meta-Analysis. *Sports Medicine*, *48*(3), 641–658. https:// doi.org/10.1007/s40279-017-0830-z

Moreira, A., McGuigan, M. R., Arruda, A. F. S., Freitas, C. G., & Aoki, M. S. (2012). Monitoring internal load parameters during simulated and official basketball matches. *Journal of Strength and Conditioning Research*, *26*(3), 861–866. htpps://doi.org/10.1519/JSC.0b013e31822645e9

Mujika, I. (2017). Quantification of training and competition loads in endurance sports: Methods and applications. In *International Journal of Sports Physiology and Performance*, 12(2), 9–17. https://doi.org/10.1123/ijspp.2016-0403

Petway, A. J., Freitas, T. T., Calleja-Gonzalez, J., Medina Leal, D., & Alcaraz, P. E. (2020). Training load and match-play demands in basketball based on competition level: A systematic review. *PloS One*, *15*(3), http:// e0229212. doi.org/10.1371/journal.pone.0229212

Pueo, B., Jimenez-Olmedo, J. M., Penichet-Tomas, A., Ortega Becerra, M., & Espina Agullo, J. J. (2017). Analysis of time-motion and heart rate in elite male and female beach handball. *Journal of Sports Science and Medicine*, *16*(4), 450–458.

Reche-Soto, P., Cardona, D., Díaz, A., Gómez-Carmona, C., & Pino-Ortega, J. (2020). Acelt y player load: dos variables para la cuantificación de la carga neuromuscular. *Revista Internacional de Medicina y Ciencias de La Actividad Física y Del Deporte, 20*(77), 167–183. https://revistas.uam.es/rimcafd/article/view/rimcafd2020.77.011/11927

Rojas-Inda, S. (2018). Análisis de carga interna y externa de futbolistas jóvenes en juegos reducidos // Analysis of internal and external load in small games in young football players. *Revista Internacional de Medicina y Ciencias de La Actividad Física y Del Deporte; Vol. 18*(71). https://doi.org/http://dx.doi.org/10.15366/rimcafd2018.71.004.

Scanlan, A. T., Fox, J. L., Borges, N. R., Ben, J, D., & Vicent J, D. (2016). Cumulative Training Dose Alters the Interrelationships Between Common Training Load Models During Basketball Activity. *International Journal of Sports Physiology and Performance*, *16*(4), 35–54.

Scanlan, A. T., Wen, N., Tucker, P. S., Borges, N. R., & Dalbo, V. J. (2014). Training mode's influence on the relationships between training-load models during basketball conditioning. *International Journal of Sports Physiology and Performance*, *9*(5), 851–856. https://doi.org/10.1123/ijspp.2013-0410

Scherr, J., Wolfarth, B., Christle, J. W., Pressler, A., Wagenpfeil, S., & Halle, M. (2013). Associations between Borg's rating of perceived exertion and physiological measures of exercise intensity. *European Journal of Applied Physiology*, *113*(1), 147–155. https://doi.org/10.1007/s00421-012-2421-x

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