Original Paper DOI: 10.5114/biolsport.2017.63381 Biol. Sport 2017;34:11-17

Session-RPE for quantifying the load of different youth basketball training sessions

AUTHORS: Lupo C[1], Tessitore A[2], Gasperi L[3], Gomez MAR[4]

[1] University of Torino, Department of Medical Sciences, School of Exercise & Sport Sciences, SUISM, Motor Science Research Center, Italy
[2] Department of movement, Human and Health Sciences; University of Rome Foro Italico, Rome, Italy
[3] School of Exercise & Sport Sciences, SUISM; University of Torino, Turin, Italy
[4] Faculty of Physical Activity and Sport Sciences, Polytechnic University of Madrid, Madrid, Spain

Corresponding author:
Corrado Lupo
University of Torino, Department of Medical Sciences, School of Exercise & Sport Sciences, SUISM, Motor Science Research Center
Address Piazza Bernini, 12
10142 Turin
Italy
E-mail: corrado.lupo@unito.it

ABSTRACT: The aim of the study was to evaluate youth basketball training, verifying the reliability of the session-RPE method in relation to session duration (< and ≥ 80 minutes) and workout typology (reduced and high warm-up, conditioning, technical, tactical, game portions within a single session) categories. Six male youth basketball players (age, 16.5±0.5 years; height, 195.5±6.75 cm; body mass, 93.9±10.9 kg; and body mass index, 23.6±2.8 kg.m^{-2}) were monitored (HR, type and duration of workouts) during 15 (66 individual) training sessions (80±26 minutes). Edwards' HR method was used as a reference measure of internal training load (ITL); the CR-10 RPE scale was administered 30 minutes after the end of each session. The results obtained showed that all comparisons between different session durations and workout portions revealed effects in term of Edwards' ITLs except for warm-up portions. Moderate to strong relationships between Edwards' and session-RPE methods emerged for all sessions (r = .85, P < .001), player's sessions (r range = .79 - .95, P < .001), session durations (< 80 minutes: r = .67, P < .001; ≥ 80 minutes: r = .75, P < .001), and workout portions (r range = .78 - .89, P range = .002 - < .001). The findings indicated that coaches of youth basketball players can successfully use session-RPE to monitor the ITL, regardless of session durations and workout portions.

CITATION: Lupo C, Tessitore A, Gasperi L, Gomez MAR. Session-RPE for quantifying the load of different youth basketball training sessions. Biol Sport. 2017;34(1):11–17.

Received: 2016-05-02; Reviewed: 2016-06-14; Re-submitted: 2016-08-04; Accepted: 2016-08-30; Published: 2016-11-11.

Key words:
Rating of perceived exertion
Heart rate
Internal training load
Situational sports
Training monitoring

INTRODUCTION

To optimize individual performances, training should be tailored to suit athletes' characteristics. Therefore, to monitor and control the training process, it is important to have a valid measure of the internal training load (ITL). In particular, the ITL represents the physiological stress imposed on the athlete in response to the training stimulus such as subjective perceptual rating of intensity (RPE), heart rate (HR), or haematological measures [1]. Although the monitoring of ITL has been effectively studied in several sport conditions [2,3], in team sports, it can be more complex due to the presence of different goals and workout settings in the same training unit (i.e., individual, small groups, etc.) [4]. As a team sport, the situational nature of basketball makes it more demanding to interpret the different performance profiles. Basketball is characterized by intermittent high-intensity actions [5,6], especially after some change of rules adopted in 2000 such as the reduction of the duration of offensive (i.e., from 30 to 24 seconds) and backcourt (i.e., from 10 to 8 seconds) actions, and a further division of the game time (from two 20-minute halves separated by a 10-minute rest period to four 10-minute quarters separated by two 2-minute rest periods between the 1st and 2nd and 3rd and 4th quarters and one 15-minute rest period between the 2nd and 3rd quarters). In addition, for youth basketball categories, Ben Abdelkrim et al. [5] reported that these changes of rules have led to an increase (i.e., > 4 beats per minute, > 2% of HR maximal value) of the athletes' cardiac efforts during competition, especially because of more frequent specific movements, accelerations, decelerations and changes of direction during running, rapid turnover and brief intense actions and the upper-body demands of shooting, passing, and rebounding. Consequently, training requires the inclusion of higher intensity and density of workouts, highlighting the need to constantly monitor the ITL, while generally the training programmes are planned according to the external training load (TL) parameters (i.e., distances travelled, action duration, technical activity repetitions, etc.).

Senior basketball players usually train from a minimum of three to a maximum of five 120-minute units per week[1] (excluding the strength training sessions) [6], while youth players train from a minimum of four 90-minute units per week[1] in the *Under 13* category to a maximum of six 120-minute units (including two strength training sessions) in the *Under 19* category [5]. However, the duration of training sessions could be modified in the presence of certain circumstances such as injuries (i.e., either intensity or duration), endurance strategies (i.e., higher duration) or avoiding fatigue in the days before official games. In addition, some parts of the basketball training sessions (i.e., physical and technical ones) are usually organized by discriminating players according to their playing position demands during a game [7,8,9], even considering small subgroups. In fact, during youth basketball games, guards usually perform a larger number of actions than that of other positional groups (i.e., forwards and centres), suggesting that this role is more involved in aspects related to ball possession (e.g., ball handling, dribbling to open spaces for teammates, passing distribution, or organizing set plays). In addition, the number of jumps performed by centres tended to be appreciably higher than forwards and guards, probably because of greater involvement in offensive and defensive rebound phases and blocking actions [5]. Therefore, it is expected that all of these game aspects are considered by coaches to effectively and specifically plan individual (or subgroup) workouts.

Considering that the HR monitoring during official competitions presents some limitations, and that athletes are able to naturally monitor their physiological stress during the practice of situational sports [4,10,11], RPE have been assessed using the category ratio [12,13] to assess the athletes' loads during both training [6,14] and competitions [15,16]. In particular, the study of Moreira et al. [15,16], on senior and youth basketball competitions, showed a greater magnitude of cortisol and session-RPE responses during official games compared to friendly ones, suggesting that a real competition generates a greater stress response. A significant relationship between ITL and TL, assessed by means of training impulse [17] and accelerometer data, was also reported in Australian male semi-professional basketball players [14]. In addition, validation of the use of the session-RPE method in basketball [13] by the consideration of the Edwards' heart rate-based method [18] has been provided by Manzi et al. [6] in Italian first division (i.e., *Serie A1*) players, reporting satisfactory individual relationships (r = .69 - .85, P < .001). Finally, Moreira et al. [15,16] validated the session-RPE in youth and adult basketball friendly and official matches by considering the hormonal responses as measurements of reference.

According to the high complexity and dynamism of youth sports [19], the use of the session-RPE method to quantify the ITL appears more necessary for the youth categories than the senior one. In fact, the session-RPE method was demonstrated to be a valuable and practical tool to monitor and plan individualized youth training [4,11,20] which can limit the occurrence of injuries, monotony, strain, overreaching and burnout in these age categories. In particular, in literature related to situational sports there have been reported lower RPE values compared the actual heart rate responses [4,10,21]. This fact might be due to the practice of open skill exercises, which determined a high level of focus on the opponents' actions and the perception of their effort as less demanding [21]. In line with this, youth water polo players showed higher correlations between Edwards' and session-RPE methods, for the swimming and individual skill training and lower ones for team tactical training and friendly matches [4].

However, in youth basketball training, no study has investigated the reliability of the session-RPE method by considering the Edwards approach as a reference, also in relation to different durations of training sessions and specific workouts. In particular, the basketball players competing into the *Under-17* category probably represent the most crucial and complex age stage to effectively develop physical and tactical aspects, strengthening the need of session-RPE to practically and regularly monitor individual ITLs. Therefore, the present study aimed to evaluate whether the session-RPE method can be a valid method to monitor ITLs performed during different training conditions in youth basketball. Specifically, it was hypothesized that: i) larger correlations (r >.7, P < .05) would emerge between session-RPE and Edwards' HR-based methods for the entire sample of all and each individual players' training sessions; ii) the Edwards values reported by male Italian *Under 17* basketball players would be affected by durations of training sessions (i.e., < 80 minutes; ≥ 80 minutes) and workout training portion within a training session (i.e., 10-20% and 20-30% of warm-up; 0-35% and 35-70% of physical training, 0-21% and 21-42% of technical workout, 0-30% and 30-60% of tactical workout, and 0-13% and 13-26% of game workout); and iii) moderate (r between .3 and .7, P < .05) to large correlations would emerge between session-RPE and Edwards' heart rate-based methods for each parameter related to specific durations of training sessions and workout training portions within a single session.

MATERIALS AND METHODS

Subjects. The institutional review board approved this study and informed consent, regarding the potential risks and benefits associated with participation, was obtained from six male youth basketball players (age = 16.5 ± 0.5 years, height = 195.5 ± 5.8 cm, body mass = 90.0 ± 11.2 kg, body mass index = 23.6 ± 2.8 $kg \cdot m^{-2}$). The athletes had to fulfil the following inclusion criteria: 1) compete in the male *2014-15 Italian Under-17 Basketball Championship*; 2) have at least 5 years of basketball training experience (consisting in a minimum of five to a maximum of seven 90-180-min training weekly sessions). In particular, all subjects involved in this study could be considered elite level athletes, having been part of a team ranked among the best eight teams at the *2014-15 Italian Under-17 Basketball Championship.*

Experimental approach to the problem

According to a previous study on senior basketball players [6], Edwards' HR-based method [18] was used as reference criterion to test the validity of the session-RPE to quantify ITL during training sessions of male youth basketball players. In particular, Edwards' HR method determines individual ITL by expressing the athletes' HR responses as percentages of their estimated maximal HR (i.e., HRmax; 220 – age) [22], multiplying the accumulated time (i.e., minutes) in five HR zones of individual HRmax (i.e., 50–60% = 1; 60–70% = 2; 70–80% = 3; 80–90% = 4; 90–100% = 5), and adding the scores.

Heterogeneous ITLs were expected for training sessions characterized by different training durations and distribution of workouts. Therefore, the ITLs related to low and high total duration and portion (established according to the mean between the minimum and maximum value of the distribution) of different workouts were discriminated. Nevertheless, in line with adjacent studies [4,6,11] related to the validity of RPE to quantify ITLs, moderate (r between .3 and .7, $P < .05$) or large ($r \geq .7$, $P < .05$) relationships between the Edwards and session-RPE methods were expected also for youth basketball training sessions.

The Italian translation of the CR-10 scale [23] modified by Foster et al. [24] was used to assess the youth soccer players' RPE [11]. The CR-10 RPE scale is a category-ratio scale characterized by scores and verbal links (i.e., from "rest" to "maximal"), referring the athlete's perception of efforts to a numerical score between 0 (i.e., rest) and 10 (i.e., maximal). In line with Foster et al. [18], in this study, the RPE was administered to youth basketball players around 30 minutes after the end of each training session to assess the ITL of the entire training session.

All training sessions were monitored during five weeks of the regular season of the *Italian Under-17 Basketball Championship*. All training sessions were scheduled in the afternoons, from Monday to Friday, at an indoor basketball court and a physical gym. Usually, coaches scheduled a higher portion of conditioning (physical) and technical workouts in the first two or three days of the week, whereas the friendly match with another same category club was organized on Wednesdays (not all weeks); finally, Thursdays and Fridays were mostly considered for technical-tactical and tactical workouts, respectively. In order to favour ecological conditions and meet the coach's training purposes, in this study no attempt was made to manipulate the contents and order of training sessions, which included different combinations of warm-up, physical, technical, tactical, and game workouts. Specifically, the warm-up period was characterized by long and short durations in relation to the following high-intensity/friendly match and medium-intensity/aerobic workouts, respectively, physical workouts, technical, tactical, and game workouts.

Procedures

During each training session, the individual HRs were recorded every 1 second using "Polar H7" (Polar Electro Oy, Kempele, Finland) HR monitors with transmitter belts placed on players' chest band linked to a wireless mobile tablet (I-pad mini 3, Apple, Infinite Loop, Cupertino, USA) by means of a Bluetooth connection, which did not interfere with other electromagnetic systems and provided reliable data. Then, the HR data were transferred onto a computer and classified according to Edwards' method to establish individual ITLs.

In order to provide a valuable overall RPE rating at the end of the training session, the athletes were familiarized with the CR-10 scale two weeks prior to the start of the experimental period. Hence, during the experimental period the players were asked to rate the intensity of each training about 30 min after its end. Then, the individual CR-10 RPE scores of each training session were multiplied for their related duration (minutes) to calculate the related session-RPE [13,24,25].

Statistical analysis

Data are presented as mean values and standard deviations. The statistical analyses were performed using the statistical software IBM SPSS Statistics for Windows (Version 21.0. Armonk, NY: IBM Corp) with a $P < .05$ alpha level of significance. Firstly, the Kolmogorov test was applied to test the normal distribution of the data. Secondly, an analysis of variance (ANOVA) for repeated measures ascertained differences between training sessions related to different duration of training sessions (i.e., < 80 minutes versus ≥ 80 minutes) and sessions with low and high portions of specific workouts (i.e., duration of warm up, physical training, technical workout, tactical, and game workout over the duration of the corresponding training session), in relation to Edwards' TLs. To provide meaningful analysis for significant comparisons from small groups, Cohen's effect sizes (ESs) were also calculated [26] for significant differences. For all significant findings, effect sizes were determined with values (negative or positive) of .2, .6, 1.2, and >1.2 indicating trivial, small, moderate, and large effect sizes, respectively [26].

The relationships between Edwards' TL and session-RPE were estimated using Pearson's product-moment correlation (i.e., r) as well as the coefficient of determination (i.e., R^2), in relation to type of training and different RPE data collections. In particular, small, moderate, large, very large and nearly perfect correlations were identified with r values corresponding to .1, .3, .5, .7 and .9, respectively [27]. Furthermore, the intra-class correlation coefficient (ICC) and the 95% confidence intervals (95% C.I.) for the correlation coefficients were calculated.

RESULTS

Sixty-six individual training sessions (1:19:31 ± 0:26:17, h:min:s) were monitored within fifteen team training sessions. The mean HR data for all individual training sessions revealed higher occurrences for the 60-70% HRmax and 70-80% HRmax (figure 1). Satisfactory reliability (ICC=.74) and a strong relationship (r = .85; 95% C.I. = .76-.91; R^2 = .72; $P < .001$) were found between the ITL of all 66 individual training sessions expressed according to Edwards' summated HR zone (192 ± 90; range: 39-402 arbitrary units, AU) and session-RPE (542 ± 227; range: 90-1040 AU) where the

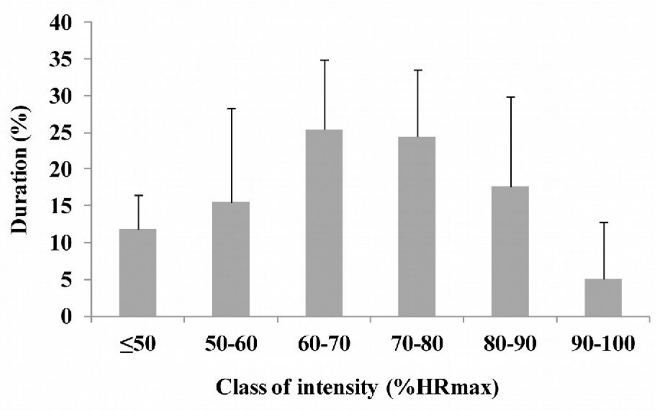

FIG. 1. Distribution of frequency of the heart rate data recoreded during all training sessions.

related RPE value was 6.7 ± 1.3 AU (range: 4-9 AU). For the 6 individual correlations (determined by a minimum of 7 to a maximum of 15 training sessions), strong correlations were found (table 1).

Strong and moderate relationships between Edwards' TL and session-RPE were identified for sessions of < 80 minutes and ≥ 80 minutes, respectively (table 2). Finally, differences between Edwards' ITLs of training sessions with reduced and high portions of specific type of workouts emerged for each training category, with the exception of warm-up, whereas the corresponding correlations between session-RPE and Edwards' values always showed large values (table 3).

DISCUSSION

The regular monitoring of young athletes' ITL is crucial to better plan their training and avoid unbalanced physiological stress which can lower the potential risk of early specialization [19], overreaching syndrome and burnout [28]. To our knowledge, this is the first study that has investigated the validity of the session-RPE method approach [24] to quantify the ITLs in youth male basketball players. The HR scenario of the male Italian *Under-17* basketball players (see figure 1) revealed lower intensities than during the *Under-19* competitions [5], probably because of different requests related to training and competition conditions, respectively. However, the gen-

TABLE 1. Players' means and standard deviations (and range) of Edwards', RPE, and session-RPE parameters (arbitrary units, AU), and individual correlations between session-RPE and Edward's values (ICC, *r*, 95% C.I., R^2, and *P* values).

Subject (S)	Edwards (AU)	RPE (AU)	Session-RPE (AU)	Edwards – session-RPE correlation indexes				
				ICC	*r*	95% C.I.	R^2	P
S1 (n=11)	233±109 (92-402)	7.5±0.8 (6-9)	566±250 (231-1040)	.82	.95	.81 - .99	.91	< .001
S2 (n=15)	205±94 (75-377)	6.2±1.3 (4-8)	506±226 (248-956)	.80	.94	.82 - .98	.88	< .001
S3 (n=9)	227±103 (89-393)	7.2±0.5 (6-8)	601±220 (357-1040)	.82	.91	.62 - .98	.82	< .001
S4 (n=7)	146±71 (39-269)	6.1±1.4 (4-8)	472±287 (90-1040)	.62	.96	.75 - .99	.93	< .001
S5 (n=11)	168±78 (69-316)	7.5±0.9 (6-9)	630±219 (360-956)	.67	.91	.68 - .98	.83	< .001
S6 (n=13)	164±60 (66-286)	6.1±1.4 (4-8)	483±185 (240-780)	.64	.80	.44 - .94	.64	< .001

TABLE 2. Differences between Edwards' ITLs of training sessions with different training durations (< 80 minutes, ≥ 80 minutes).

Training variable (effects for Edwards)	Portion of training session	Edwards (arbitrary units)	RPE (arbitrary units)	Session-RPE (arbitrary units)	Edwards – session-RPE correlation indexes				
					ICC	*r*	95% C.I.	R^2	P
Training duration (P < .001; ES = 1.8)	< 80 minutes (n=41)	145±56 (39-286)	6.7±1.2 (4-9)	419±115 (90-604)	.69	.67	.44 - .80	.44	< .001
	≥ 80 minutes (n=25)	271±80 (138-404)	6.8±1.4 (4-9)	743±222 (324-1040)	.65	.75	.50 - .88	.57	< .001

Note: data are means and standard deviations (and range) of Edwards', RPE, and session-RPE parameters (arbitrary units, AU) in relation to each duration category of analyzed training sessions, and corresponding correlations between session-RPE and Edward's values (ICC, *r,* 95% C.I., R^2, and *P* values).

TABLE 3. Differences between Edwards' ITLs of training sessions with reduced and high portion of specific type of workouts (i.e., warm-up, conditioning, technical, tactical, game).

Training type (differences related to Edwards ITLs)	Portion of training session	Edwards (AU)	RPE (AU)	Session-RPE (AU)	Edwards – session-RPE correlation indexes ICC	r	95% C.I.	R^2	P
Warm-up (P>.05; ES=.2)	10-20% (n=45)	197±96 (66-402)	6.6±1.2 (4-9)	552±248 (231-1040)	.79	.87	.77-.93	.75	<.001
	20-30% (n=21)	182±77 (39-355)	6.9±1.4 (4-9)	520±175 (90-832)	.76	.79	.54-.91	.62	<.001
Conditioning (P=.022; ES=.8)	0-35% (n=54)	204±91 (66-402)	6.6±1.2 (4-9)	564±236 (231-1040)	.78	.85	.75-.91	.72	<.001
	35-70% (n=12)	139±61 (39-264)	7.3±1.2 (4-9)	441±147 (90-600)	.72	.79	.39-.94	.63	.002
Technical (P=.032; ES=.5)	0-21% (n=33)	169±84 (39-372)	6.8±1.4 (4-9)	498±203 (90-950)	.75	.79	.61-.89	.62	<.001
	21-42% (n=33)	216±90 (75-402)	6.6±1.1 (4-8)	586±243 (231-1040)	.78	.89	.79-.94	.79	<.001
Tactical (P=.013; ES=.4)	0-30% (n=27)	173±66 (39-355)	6.9±1.3 (4-9)	505±159 (90-832)	.64	.78	.57-.89	.60	<.001
	30-60% (n=39)	206±102 (66-402)	6.6±1.2 (4-9)	567±263 (231-1040)	.79	.87	.76-.93	.75	<.001
Game (P=.004; ES=.5)	0-13% (n=49)	202±95 (66-402)	6.6±1.2 (4-9)	563±244 (231-1040)	.79	.86	.76-.92	.74	<.001
	13-26% (n=17)	164±66 (39-264)	7.0±1.4 (4-9)	480±157 (90-780)	.75	.77	.46-.91	.59	<.001

Note: Data are means and standard deviations (and range) of Edwards', RPE, and session-RPE parameters (arbitrary units, AU) in relation to each type and portion of training session, and corresponding correlations between session-RPE and Edwards' values (ICC, r, 95% C.I., R^2, and P values).

eral (r = .85, ICC = .74) and individual (r range =.80 - .95, ICC range =.62 - .82; see table 1) correlations and reliabilities found between Edwards and session-RPE values with our male youth basketball players were quite satisfactory and in line with those reported in senior basketball [6] and other team situational sports such as water polo [4], soccer [11] and Australian Football [1]. Thus, the present findings fully confirm the first hypothesis.

The second hypothesis can be partially accepted because the comparison between Edwards' values related to training sessions with reduced and high portions of warm-up did not show a statistically significant difference. However, in terms of Edwards' ITLs, identified effects emerged between: reduced and high total training durations, and portions of conditioning, technical, tactical and game workouts within a single session.

As expected, Edwards' ITLs were influenced by the training session duration, showing higher values in association with longer training sessions. However, in line with previous studies on other situational sports [11,20], this effect could be further explained according to the HR scenario for which ≥ 80 minute training sessions (>80% HRmax = 20 ± 17% of session) were mostly characterized by lower occurrence of maximal intensities than those of < 80 minutes of total duration (>80% HRmax = 28 ± 19% of session). As a consequence, the huge difference that was highlighted by the large ES (table 2) can be principally attributed to the combination of the duration and intensity results mentioned above.

In terms of workout training portions within a single session, the absence of a significant effect between Edwards' ITLs related to reduced and high portions of warm-up could be attributed to the two restricted categories (i.e., 10-20% and 20-30% of total session duration) determined by a quite standard training protocol, which is mostly conducted at a low-medium intensity.

Differently from the warm-up portions of training sessions, the effects observed between reduced and high portions of conditioning, technical, tactical, and game show how these parts of training influenced the ITL of an entire session. However, it was found that high portions of conditioning and game workout decrease the ITL, whereas the opposite picture emerged for technical and tactical workouts. These results seem to conflict with those of previous studies [6,8,9] on players' basketball training in which the sessions dedicated to strength and conditioning and technical/tactical workouts showed the highest and lowest ITL levels, respectively. However, it has to be considered that the conditioning training of the Italian *Under-17* players was also affected by the presence of four weight-lifting sessions in the gym (usually characterized by low density of exercise with 2-3 minutes of rest periods) before the physical training on court, which probably determined a low intensity of the entire session. Additionally, the latter findings are in line with the results of Scanlan et al. [14] which highlighted greater intermittent (and lateral movement) basketball players' requirements during sport-specific workouts than field-based team sports.

The monitoring of the ITL revealed higher Edwards' values in association with high technical and tactical workout portions within a single sessions, suggesting that the coaches' directions can determine high training intensities. In fact, although a part of the technical and tactical workouts was conducted with the first objective of improving the quality of individual and team movements, several sessions were also performed to mainly train conditional capabilities. Although the play with the ball seems to favour high-intensity performance in the technical and tactical workouts, a different picture emerged for the game portions. In fact, considering that, for this type of training, the coach used to organize two teams selecting players of his team, it could be inferred that non-official game conditions favoured sub-maximal intensities, principally due to the tendency to minimize the possibility of injuries and the coach's interruptions to explain playing movements.

Finally, the third hypothesis can be accepted because strong correlations were found between session-RPE and Edwards' heart rate-based methods for each parameter related to durations of training sessions and workout training portions within a single session. Actually, only the < 80 minutes training category showed a moderate (r = .67) correlation between the two methods (with a large reliability; ICC = .69), probably due to the presence of 8 very short sessions (duration range = 33-51 minutes) characterized by less comfortable individual conditions (i.e., after injuries, day before an official game, illness), which diminish the objective perception of ITL, as demonstrated by the reliability (ICC =.3) and correlation (r = .26, 95% C.I. = -.54-.82, R^2 = .07, p > .05) values. However, this is just a particularity and, according to a previous study on youth taekwondo athletes [20], session duration marginally influenced the session-RPE reliability, differently from the intensity. In fact, considering each couple of compared variables (i.e., reduced versus high session duration; table 2) and type (i.e., reduced versus high warm-up, conditioning, technical, tactical, and game session portions; table 3), higher correlations regularly emerged related to the higher Edwards' ITL results. Therefore, regardless of whether future studies on youth basketball players' session-RPE will be able to confirm these findings, it could be suggested that, for male *Under-17* basketball players, the increase of Edwards' ITL improves the subjective reliability of the ITL perception. In addition, similarly to the same age water polo players [4], it could also be speculated that the session-RPE method is a reliable method in youth basketball training, also regardless of the coaches' choices of privileging different types of workouts within a single training session.

This study showed the effectiveness of the session-RPE to evaluate the male *Under-17* basketball players' training. Therefore, basketball coaches could benefit by the use of this method, being very practical to monitor youth ITL and to avoid the necessity of expensive tools (i.e. telemetric HR systems, hormonal examinations, lactate analyzers). In consequence, monitoring the ITL in youth basketball players is also crucial to plan future appropriate training programmes, which regularly tend to limit the occurrence of injuries, monotony, strain, overreaching conditions, and burnout, and to examine the effects of specific periodization strategies for the team in general and the player specifically. In particular, the results of the present study contributed to improving the coaches' awareness of ITLs, even considering different training durations and a reduced or high portion of proposed workouts.

CONCLUSIONS

In general, youth competition and training are doubtfully planned in favour of early specialization [19], determining a progressive necessity to regularly monitor the young athletes' ITL. Therefore, the present findings could be a valuable reference to promote the session-RPE as a useful tool for monitoring ITL in youth basketball training. However, considering that this study was exclusively focused on training sessions, further research should be promoted for the session-RPE reliability in relation to different genders, tactical roles (i.e., small versus big players), seasonal periods (i.e., pre-season versus in-season), and competitive contests (i.e., friendly game, low-importance and crucial official game).

Conflict of interests: the authors declared no conflict of interests regarding the publication of this manuscript.

REFERENCES

1. Scott T, Black C, Quinn J, Coutts AJ. Validity and reliability of the session-RPE method for quantifying training in Australian football: A comparison of the CR10 and CR100 scales. J Strength Cond Res. 2013;27:270-276.
2. Nummela A, Hynynen E, Kaikkonen P, Rusko H. High-intensity endurance training increases nocturnal heart rate variability in sedentary participants. Biol Sport. 2016;33:7-13.
3. Ciolac EG, Mantuani SS, Neiva CM, Verardi CEL, Pessôa-Filho DM, Pimenta L. Rating of perceived exertion as a tool for prescribing and self regulating interval training: a pilot study. Biol Sport. 2015;32:103-108.
4. Lupo C, Capranica L, Tessitore A. The Validity of Session-RPE Method for Quantifying Training Load in Water Polo. Int J Sports Physiol Perform. 2014;9(4):656-660.
5. Ben Abdelkrim N, El Fazaa S, El Ati J. Time-motion analysis and physiological data of elite under-19-year-old basketball players during competition. Br J Sports Med. 2007;41:69-75.
6. Manzi V, D'ottavio S, Impellizzeri F, Chaouachi A, Chamari K, Castagna C. Profile of weekly training load in elite male professional basketball players. J Strength Cond Res. 2010;24(5):1399-1406.

7. Conte D, Favero TG, Lupo C, Francioni FM, Capranica L, Tessitore A. Time-motion analysis of Italian elite women's basketball games: individual and team analyses. J Strength Cond Res. 2015;29(1):144-150.
8. Ortega, E, Cárdenas, D, Sainz de Baranda, P, Palao, JM. Differences in competitive participation according to player's position in formative basketball. J Hum Mov Stud. 2006;50(2):103-122.
9. Ortega, E, Cárdenas, D, Sainz de Baranda, P, Palao, JM. Analysis of the final actions used in basketball during formative years according to player's position. J Hum Mov Stud. 2006;50(6):421-437.
10. Casolino E, Cortis C, Lupo C, Chiodo S, Minganti C, Capranica L. Physiological versus psychological evaluation in taekwondo elite athletes. Int J Sports Physiol Perform. 2012;7(4):322-331.
11. Impellizzeri FM, Rampinini E, Coutts AJ, Sassi A, Martora SM. Use of RPE based training load in soccer. Med Sci Sports Exerc. 2004;36(6):1042-1047.
12. Borg G. Borg's perceived exertion and pain scales. Champaign, IL: Human Kinetics; 1998.
13. Foster C, Florhaug JA, Franklin J, Gottschall L, Hrovatin LA, Parker Doleshal P, Dodge C. A new approach to monitoring exercise training. J Strength Cond Res. 2001;15(1):109-115.
14. Scanlan AT, Wen N, Tucker PS, Dalbo VJ. The relationships between internal and external training load models during basketball training. J Strength Cond Res. 2014;28(9):2397-2405.
15. Moreira AL, Crewther BT, Freitas CG, Arruda AFS, Costa EC, Aoki MS. Session RPE and salivary immune-endocrine responses to simulated and official basketball matches in elite young male athletes. J Sports Med Phys Fitness. 2012;52:682-687.
16. Moreira AL, Mcguigan MR, Arruda AFS, Freitas CG, Aoki MS. Monitoring internal load parameters during simulated and official basketball matches. J Strength Cond Res. 2012;26(3):861-866.
17. Banister EW. Modeling elite athletic performance. In: Green H, McDougal J, Wenger H, ed. Physiological Testing of Elite Athletes. Champaign, IL: Human Kinetics; 1991:403-424.
18. Edwards S. The heart rate monitor book. Sacramento, CA: Fleet Feet Press; 1993.
19. Capranica L, Millard-Stafford ML. Youth sport specialization: how to manage competition and training? Int J Sports Physiol Perform. 2011;6(4):572-579.
20. Haddad M, Chaouachi A, Wong DP, Castagna C, Hue O, Impellizzeri FM, Chamari K. Influence of exercise intensity and duration on perceived exertion in adolescent Taekwondo athletes. Eur J Sport Sci. 2014;14(S1),275-281.
21. Bridge CA, Jones M, Drust B. Physiological responses and perceived exertion during international taekwondo competition. Int J Sports Physiol Perform. 2009;4(4):485-493.
22. Fox III SM, Naughton JP, Haskell, WL. Physical activity and the prevention of coronary heart disease. Ann Clin Res. 1971;3:404-432.
23. Borg G. Psychophysical bases of perceived exertion. Med Sci Sports Exerc. 1982; 14(5):377-381.
24. Foster C, Hector L, Welsh R, Schrager M, Green M, Snyder A. Effects of specific versus cross-training on running performance. Eur J Appl Physiol Occup Physiol. 1995;70(4):367-372.
25. Foster C, Daines E, Hector L, Snyder A, Welsh R. Athletic performance in relation to training load. Wis Med J. 1996;95(6):370-374.
26. Cohen J. Statistical Power Analysis for the Behavioral Sciences (2nd ed.). Hillsdale, NJ: Lawrence Erlbaum Associates, 1988.
27. Hopkins WG, Marshall, SW, Batterham, AM, Hanin, J. Progressive statistics for studies in sports medicine and exercise science. Med Sci Sports Exerc. 2009;41:3-13.
28. Brenner JS. Overuse injuries, overtraining, and burnout in child and adolescent athletes. Pediatrics. 2007;19(6):1242-1245.