Ann Appl Sport Sci, 12(S2): e1327, 2024.
http://www.aassjournal.com; e-ISSN: 2322–4479; p-ISSN: 2476–4981. 10.61186/aassjournal.1327

ORIGINAL ARTICLE

The Effects of Additional Plyometric Training on Indicators of Subjective Training Load in Football

[1]Marin Dadic, [1]Luka Milanovic, [1]Ivan Belcic*, [1]Ivan Krakan, [2]Mario Lovric

[1]Department of Sport, Faculty of Kinesiology, University of Zagreb, Zagreb, Croatia. [2]Department of Sport, Faculty of Kinesiology, University of Osijek, Osijek, Croatia.

Submitted December 12, 2023; Accepted in final form February 15, 2024.

ABSTRACT

Background. One of the most effective methods for progressing fast and explosive movements, essential in football players' performance, is plyometric training, which includes activities and movements whose performance depends on the stretch and shortening cycle. **Objectives.** The problem of this research is related to monitoring the subjective feeling of load and the feeling of physiological and psychological stress under the influence of plyometric training and whether the said low-volume training impacts the internal experiences of the load of young football players. **Methods.** The sample of respondents consisted of 33 junior football players who played club football at 17.3±0.9. The experimental training program lasted six weeks, and subjective parameters for training load were monitored daily through RPE and wellness questionnaires. **Results.** The results of this study showed that additional plyometric training does not significantly affect the participants' subjective feeling of load during six weeks. Significant differences between the experimental and control group participants were found in wellness in the first and second weeks of the experimental procedure (<0.005 and 0.017). In contrast, no significant differences were found in wellness from the experimental procedure's third to sixth week. **Conclusion.** Daily monitoring of the subjective feeling of load is a good tool for controlling athletes. This especially applies to younger athletes because it is a highly effective tool available to everyone and does not require financial expenses.

KEYWORDS: ***Wellness Questionnaire, RPE, Football Training, Youth Players.***

INTRODUCTION

The dynamics of the football game, both through training and competition, are characterized by alternating high-intensity and low-intensity activities that are constantly alternating (1). Football players cover 10-13 km during a match and perform approximately 1350 activities (every 4-6 seconds), such as accelerations and stops, changes in the direction of movement, and jumps (2). Given the above, the football player's capacity for performing fast and explosive movements dramatically impacts the quality of the football player's performance during training and matches (3–5).

Plyometric training is a popular and effective method for improving the mentioned activities (6, 7). Plyometric training is characterized by training content based on the muscle stretch and shortening cycle. Plyometric exercises aim to adapt the nervous and muscle-tendon systems to produce the greatest possible mechanical force for the shortest possible period (8). Given that it has already been said that the football game contains many short, high-intensity activities, it can be concluded that plyometric training is an excellent training method for improving these essential motor skills in football players (9).

*. Corresponding Author:
Ivan Belcic, Ph.D.
E-mail: ivan.belcic@kif.hr

Likewise, to increase football players' performance and reduce the occurrence and risk of injuries, many football clubs have sports scientists in their professional staff who monitor the total training load daily (10). The total training load is most often considered through the prism of external and internal load parameters. The total distance run most often characterizes external load parameters, the number of sprints during training or a match, the total number of stops, and other factors of external load parameters. On the other hand, internal parameters are related to the athlete's physiological response to activity, such as heart rate, blood lactate level, or the more frequently used method in football, the subjective experience of the total load during training or a match (11). Due to this research's goal and problems, the internal load parameters and the influence of plyometric training on them will be explained in the following text.

Plyometric training includes activities and movements whose performance depends on the stretch and shortening cycle. The content of plyometric training is most often characterized by hops, jumps, lunges, and leaps, which can be of unilateral or bilateral character with different directions, so it is easy to conclude that plyometric training describes the speed of movement during the performance of a particular exercise. The cycle of muscle stretching and shortening is the link between strength, power, and speed. Considering the above, this type of training increases force production and improves sports performance during training or competition. Dynamic muscle work in which the athlete overcomes a particular force at a particular movement speed is the basis of energy production; therefore, muscle power is defined as the speed at which the muscles perform some work (12). Plyometric training and its contents can be defined as the type of exercise that connects muscle strength with the speed of movement (13). Depending on the time of contact with the surface, it is defined by slow (>250) and fast (<250) cycles of stretching and shortening of muscles. Including plyometric training in the programs of young football players opens the possibility of improving many motor skills (14) and reducing the risk of injury (15).

The problem of this research is related to monitoring the subjective feeling of load and the feeling of physiological and psychological stress under the influence of plyometric training and whether the said low-volume training impacts the internal experiences of the load of young football players. This research also determined whether additional plyometric training significantly changes the internal subjective training load (sRPE) parameters and the subjective feeling of psychological and physiological stress in football players (Wellness questionnaire). Monitoring training load can be viewed in the context of maximizing training effects, reducing the incidence of injuries (16), and reducing the risk of overtraining (17). Also, due to the connection between the volume of training and the occurrence of injuries, monitoring the load in players of younger age categories is an essential factor in training (18). Research results on young athletes show that due to growth and maturation stages, a good choice of training technologies (19) and a good distribution of training load and volume make a sports career longer (20). However, monitoring the load components can often be a problem for coaches and sports club employees, given that specific methods require a high level of professional knowledge as well as financial expenses of the club. Therefore, in this research, load monitoring variables were applied through subjective load monitoring, which represents a simple, accessible, and effective method of load monitoring. The previous sentence can be confirmed by its high correlation with heart rate, blood parameters, and the level of lactate concentration in the blood (21). In addition, the correlation and connection with external load parameters show that subjective load assessment can be a perfect tool for assessing the total training load in football players of younger age categories (22). Using excellent and valid tools during each training session to monitor the total training load (TL - training load) is essential for optimal adaptation of athletes to training and competition and for avoiding overtraining (23). According to Foster et al. (24), monitoring training load based on the athlete's subjective experience of training load (sRPE - session rate of perceived exertion) can be a good indicator of both intensity and training volume.

The paper will analyze whether the subjective experience of training with additional plyometric training significantly differs in the parameters of subjective internal training load (sRPE) and the subjective feeling of

psychological stress in football players (Wellness questionnaire). Following the objectives, the following hypotheses are set:

• Additional plyometric training during the competitive season will result in significant changes in the parameters of subjective internal training load and the subjective feeling of psychological stress of football players.

• Additional plyometric training will not cause statistically significant differences in the subjective load evaluation between the experimental and control groups.

• Additional plyometric training will not cause statistically significant differences between the experimental and control groups in the subjective assessment of psychological stress.

MATERIALS AND METHODS

Ethics Committee approval. This study was approved by the Faculty of Kinesiology Ethics Committee (Protocol 09/2021 on September 20, 2021), University of Zagreb, and was carried out per the Helsinki Declaration. Examinees have signed statements expressing their willingness to proceed with the research.

Participants. The sample of participants consisted of 33 junior football players who played club football at 17.3±0.9. During the experimental procedure, this club's respondents were the 2nd Croatian Football League Center participants in the 2020/2021 season. The research participants were randomly divided into two groups: the experimental group, which performed additional plyometric training in addition to standard football training (body height: 180.52±6.86, body weight: 69.8.0±7.2, and percentage of subcutaneous adipose tissue: 10.5±0.9) and a control group that during the experimental procedure performed standard football training, without additional plyometric training (body height: 180.40±4.88, body weight: 71.0±7.9 and percentage of subcutaneous fat tissue: 10.6±1.0). Before the experimental procedure, during the interview, the respondents received clear information that they did not conduct additional football or fitness training during the experimental procedure.

Procedure. After the initial testing, the participants were randomly assigned to control and experimental groups. Both groups were formed by drawing pieces of paper with the names and surnames of the respondents. The total number of participants at the beginning of the measurement was 34. One subject from the control group did not complete the experimental procedure because he left the club, so the research was completed with 33 participants. The experimental group consisted of 17 participants, while the control group consisted of 16 participants. During the experimental procedure, the participants from both groups did not attend any additional work directed towards technical-tactical preparation or fitness preparation. The interviews with the players before the initial testing included questions about the training history of plyometric training; during the conversation, it was noticed that the test participants of the experimental and control groups were familiar with the mentioned training technology, and throughout the season, they practiced jumping exercises concerning the plan and program.

The experimental procedure lasted six weeks, with 30 technical and tactical sessions, 7 matches, and five days off. The experimental training program included with the experimental group four additional plyometric trainings per week before football training for 15 minutes for six weeks. Participants of the experimental group came to the football field 20 minutes before the start of training and spent extra 5 minutes of warm-up for plyometric training (front leg from skip in movement 1x6+6 repetitions each leg, legs from the skip in the movement 1x6+6 repetitions each leg, alternately shifting the weight from one leg to the other in a wide stance 1x6+6 repetitions, alternating flexion in the knee joint with pulling the leg 1x4+4 repetitions each leg, alternating heel to the floor in support of the outstretched arms 1x5+5 repetitions each leg), along with standard warm-up protocol and 15 minutes of additional plyometric training. Plyometric training included jumps of a bilateral and unilateral nature with vertical, horizontal, and lateral directions. It is important to note that the progressiveness in the intensity of the experimental program was designed in such a way that the complexity of the content, the height of the jumps, and the number of repetitions and series increased from week to week, respecting the methodical principles of training and progressiveness (Table 1). For six weeks, the control group performed only standard football training without additional plyometric training, which was aimed at developing specific fitness preparation and perfecting football players' technical and tactical skills.

Likewise, the experimental procedure included monitoring the subjective feeling of exertion (sRPE) at the end of the training. The experimental and control group participants evaluated the subjective feeling of training load on a scale of 1-10, precisely 30 minutes after the training (24). The respondents were familiar with evaluating the feeling of the training load since, throughout the entire season, they evaluated their subjective condition with the fitness trainer in the club in the way mentioned above.

In addition to the internal subjective monitoring of the workload, the respondents evaluated their current experience of psychological and physiological stress every morning via mobile message. For this purpose, a wellness questionnaire was used to assess physiological and psychological stress (25), in which participants rated the variables of sleep quality, fatigue, muscle fatigue, stress, and satisfaction on a Likert scale of 1-5 with the option of rating 0, 5. The participants of the experimental and control groups sent the evaluations of individual variables via mobile message to the fitness trainer employed at the club every morning after waking up, indicating the answer for the previous day. The total current state was defined by summing the results of all five questions. It is important to note that the markers of the athletes' current condition were monitored through the wellness questionnaire throughout the season, and the respondents were familiar with the procedure and method of assessment.

Table 1. Experimental program during six weeks

Week	Number of exercises	Number of series	Complexity	Number of jumps
1.	12	34	low	240
2.	12	31	low	223
3.	12	25	medium	218
4.	12	32	medium	278
5.	12	31	high	258
6.	12	33	high	298
Total	**72**	**186**	-	**1.515**

Data Analysis. The software STATISTICA for Windows version 13.4 (StatSoft, Inc., Tulsa, OK) was used to process the results of the variables of the space of morphological characteristics, motor abilities, functional abilities, and the variables of the subjective experience of the load of the participants. Descriptive statistics with arithmetic mean and standard deviation were calculated for all measured parameters. The normality of the distributions was tested with the Kolmogorov-Smirnov test. Non-parametric statistical tests (Friedmann ANOVA test and Mann Whitney U Test) were used for variables whose distribution deviated from the average.

The analysis for the variables in which the distributions were determined to be expected was the analysis of variance for repeated measurements (2x2 ANOVA), which was used to determine the analysis of differences between groups after the experimental program. The statistical significance of differences in all data processing methods was set at $p<0.05$.

RESULTS

The effects of additional plyometric training on the subjective experience of training load. The Kolmogorov-Smirnov test determined that the results of three weeks out of the six-week experimental procedure deviated from the normal distribution. Analysis of differences in weeks for results deviating from a normal distribution will use non-parametric statistical processing using the Mann-Whitney U test, and for customarily distributed results, one-way ANOVA analysis of variance will be used (Table 2).

The effects of additional plyometric training on the subjective experience of training load in the first week of the experimental procedure. The results of the Mann-Whitney U test showed no significant differences between the experimental and control groups of participants in the subjective experience of the load from the first to the sixth week of the experimental procedure (Table 3).

The results of the Mann-Whitney U test showed significant differences between the experimental and control group participants in wellness in the first and second weeks of the experimental procedure. In contrast, no significant differences were found between the experimental and control group participants in wellness from the third to the sixth week of the experimental procedure (Table 4).

Table 2. Kolmogorov-Smirnov test of normality of distribution

Week	Max D	K-S *p*	Critical value
1	0.121	p<0.20	0.233
2	0.183	p>0.20	0.233
3	0.158	p>0.20	0.233
4	0.216	p<0.10	0.233
5	0.196	p<0.15	0.233
6	0.130	p>0.20	0.233

Table 3. Differences between groups in the subjective feeling of burden for the six weeks

Week	U	Z	*p*
1	103.00	-1.170	0.241
2	0.053	0.001	0.816
3	0.512	0.016	0.480
4	132.00	0.126	0.899
5	131.00	-0.126	0.871
6	0.223	0.006	0.645

Table 4. Differences between groups in wellness for the six weeks

Week	U	Z	*p*
1	51.50	3.025	<0.005
2	6.35	0.169	0.017
3	2.54	0.757	0.121
4	85.00	1.819	0.065
5	92.50	1.548	0.121
6	2.55	0.076	0.120

DISCUSSION

The results of this study showed that additional plyometric training does not significantly affect the participants' subjective feeling of load during six weeks. The training design of the study itself was focused on additional plyometric training of low volume for 15 minutes and high frequency four times a week. The results show that this training program has a significant effect on some variables of fitness abilities without a significant difference in the results of the subjective feeling of load in both groups of participants. The practical contribution of this research can be seen in the context of the previous sentence, where it is evident that with a small amount of time, additional plyometric training can influence the development of the motor skills of young football players without affecting their experience of the training itself. As values of the subjective sense of load are most often used as markers of training intensity, there is evidence that it can be used and be sensitive to other external parameters of training load, such as volume or duration (26). The results of this research support the research results of Foster et al. (24), who recorded the values of internal load parameters on a bicycle ergometer during training lasting 30, 60, and 90 minutes at an intensity of 90% of the anaerobic threshold of each subject. The authors of this research concluded that increasing the training volume does not significantly increase the subjective feeling of load measured 30 minutes after training. Likewise, Green et al. (26) monitored the values of the subjective feeling of load after running training on a treadmill of different volumes. The participants ran for 20, 30, and 40 minutes at an intensity of 70% VO2max. The results showed no significant differences in the parameters of the subjective feeling of load; however, a trend of increasing results was observed in the longer-run sections. However, in contrast to the studies mentioned above, de Jesus et al. (27) tried to determine the impact of the duration of training with different intensities on the participants' subjective sense of workload. Based on the results, they concluded that the training volume can affect the subjective feeling of the load together with the intensity. The research of Fusco et al. (28) on young swimmers tried to determine whether the training volume affects the increase in the subjective feeling of training load. The results showed an increase in the value of sRPE in swimming sections with the same

intensity but with a higher volume, thus realizing that the training volume can be a factor that affects the change in the subjective experience of the load. Given that, according to the available information and this research, this is the first study that studies the connection and impact of plyometric training on internal load variables in football players, the results show that the volume and intensity of additional plyometric training did not significantly affect changes in the subjective feeling of load.

Also, this is the first study that studies the connection of plyometric training with the psychological and physiological experience of the load obtained through the wellness questionnaire. The results show significant differences between the experimental and control groups in the first two weeks of the experimental procedure, while in the other four weeks, there are no statistically significant differences in the results. As the average scores of the questionnaire in the control group were significantly lower and the overall wellness of the young football players from this group during the first two weeks of the program was impaired, this can be explained by the matches played during the first two weeks of the experimental procedure. In the summary parameters during the six weeks of realization of the experimental procedure, it is evident that 4 competitive matches were realized during the first two weeks. This factor may influence impaired wellness since 44% of the control group participants participated in the first line-up during those matches. The results of this research and the decrease in the level of wellness during the first two weeks in the control group are also confirmed by the research of O'Connor et al. (29) and Morgan et al. (30); significant worsening of psychological and physiological stress experience ratings was recorded. Likewise, Hooper et al. (25) observed an increase in the level of muscle fatigue during the competitive period in the increased training volume in elite swimmers. In the mentioned research, they realized that the accumulation of training load can lead to an increase in athletes' perception in the context of muscle fatigue. Also, research by Moall et al. (31) showed a significant correlation between increased training days and reduced wellness in elite football players over 16 weeks. Likewise, Thorpe et al. (32) noted in their research a significant correlation between the increased workload of one training day and the feeling of fatigue during the competitive period of top football players. Also, as in previous research, Buccheit et al. (33) found that changes in the total training load during the preparatory period can be observed in top Australian football players using the feeling of psychological and physiological fatigue and heart rate variability.

CONCLUSION

Considering the aim of the work, which was to determine whether plyometric training of high frequency and low volume impacts the subjective experience of training load, the results showed that the experimental group did not have a significantly increased experience of training load. Considering the above, it can be concluded that high-frequency and low-volume plyometric training can be an excellent tool for young football players through which the abilities necessary for success in football can be developed. In addition, this type of training and these training modalities do not significantly affect the experience of training load measured through RPE and wellness questionnaires.

APPLICABLE REMARKS

- The scientific contribution of this work is in favor of the fact that additional plyometric training lasting 15 minutes 4 times a week does not significantly affect the increase in RPE and wellness; therefore, it can be concluded that low-volume training that affects increasing fitness abilities in football players will not significantly increase the experience of psychological and physiological stress.
- Daily monitoring of the subjective feeling of load is a good and essential tool for controlling athletes. This especially applies to younger athletes because it is a highly effective tool available to everyone and does not require financial expenses.
- Educated experts in the field of strength and conditioning of athletes can monitor and plan the activities of their athletes simply and effectively using RPE and wellness questionary.

ACKNOWLEDGMENTS

The authors would like to thank all participants for their voluntary efforts in this research.

AUTHORS' CONTRIBUTIONS

Study concept and design: Marin Dadic, Luka Milanovic. Acquisition of data: Ivan Belcic. Analysis and interpretation of data: Ivan Krakan.

Drafting the manuscript: Marin Dadic, Ivan Belcic, Ivan Krakan. Critical revision of the manuscript for important intellectual content: Luka Milanovic. Statistical analysis: Mario Lovric. Administrative, technical, and material support: Mario Lovric. Study supervision: Marin Dadic, Luka Milanovic, Ivan Belcic.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

ETHICAL CONSIDERATION

This study was approved by the Ethics Committee of the Faculty of Kinesiology, University of Zagreb, and carried out in accordance with the Helsinki Declaration. The examinees signed a statement expressing their willingness to proceed with the research.

FUNDING/SUPPORT

This study was fully supported by the Faculty of Kinesiology, University of Zagreb–authors' affiliation.

ROLE OF THE SPONSOR

The funding organizations are public institutions and have no role in the design and conduct of the study, collection, management, and analysis of the data or preparation, review, and approval of the manuscript.

FINANCIAL DISCLOSURE

The authors have no financial interests related to the material in the manuscript.

ARTIFICIAL INTELLIGENCE (AI) USE

There was NO use of artificial intelligence (AI) for preparation, writing, or editing this manuscript.

REFERENCES

1. Glaister M. Multiple sprint work : physiological responses, mechanisms of fatigue and the influence of aerobic fitness. Sports Med. 2005;35(9):757–77. [doi:10.2165/00007256-200535090-00003] [PMid:16138786]
2. Mohr M, Krustrup P, Bangsbo J. Fatigue in soccer: a brief review. J Sports Sci. 2005 Jun;23(6):593–9. [doi:10.1080/02640410400021286] [PMid:16195008]
3. Christopher J, Beato M, Hulton AT. Manipulation of exercise to rest ratio within set duration on physical and technical outcomes during small-sided games in elite youth soccer players. Hum Mov Sci. 2016 Aug;48:1–6. [doi:10.1016/j.humov.2016.03.013] [PMid:27082027]
4. Mohr M, Krustrup P, Bangsbo J. Match performance of high-standard soccer players with special reference to development of fatigue. J Sports Sci. 2003 Jul;21(7):519–28. [doi:10.1080/0264041031000071182] [PMid:12848386]
5. Zamparo P, Zadro I, Lazzer S, Beato M, Sepulcri L. Energetics of shuttle runs: the effects of distance and change of direction. Int J Sports Physiol Perform. 2014 Nov;9(6):1033–9. [doi:10.1123/ijspp.2013-0258] [PMid:24700201]
6. Markovic G, Mikulic P. Neuro-musculoskeletal and performance adaptations to lower-extremity plyometric training. Sports Med. 2010 October 1;40(10):859–95. [doi:10.2165/11318370-000000000-00000] [PMid:20836583]
7. Slimani M, Chamari K, Miarka B, Del Vecchio FB, Chéour F. Effects of Plyometric Training on Physical Fitness in Team Sport Athletes: A Systematic Review. J Hum Kinet. 2016 Oct 14;53:231–47. [doi:10.1515/hukin-2016-0026] [PMid:28149427]
8. Wang YC, Zhang N. Effects of plyometric training on soccer players. Exp Ther Med. 2016 Aug;12(2):550–4. [doi:10.3892/etm.2016.3419] [PMid:27446242]
9. Berryman N, Maurel DB, Bosquet L. Effect of plyometric vs. dynamic weight training on the energy cost of running. J Strength Cond Res. 2010 Jul;24(7):1818–25. [doi:10.1519/JSC.0b013e3181def1f5] [PMid:20543734]
10. McCall A, Davison M, Andersen TE, Beasley I, Bizzini M, Dupont G, et al. Injury prevention strategies at the FIFA 2014 World Cup: perceptions and practices of the physicians from the 32 participating national teams. Br J Sports Med. 2015 May;49(9):603–8. [doi:10.1136/bjsports-2015-094747] [PMid:25878078]
11. Wallace LK, Slattery KM, Coutts AJ. A comparison of methods for quantifying training load: relationships between modelled and actual training responses. Eur J Appl Physiol. 2014 Jan;114(1):11–20. [doi:10.1007/s00421-013-2745-1] [PMid:24104194]

12. Smith JJ, Eather N, Morgan PJ, Plotnikoff RC, Faigenbaum AD, Lubans DR. The health benefits of muscular fitness for children and adolescents: a systematic review and meta-analysis. Sports Med. 2014 Sep;44(9):1209–23. [doi:10.1007/s40279-014-0196-4] [PMid:24788950]
13. Faigenbaum AD. Strength Training For Children And Adolescents. Clinics in Sports Medicine. 2000 Oct 1;19(4):593–619. [doi:10.1016/S0278-5919(05)70228-3] [PMid:11019731]
14. Bedoya AA, Miltenberger MR, Lopez RM. Plyometric Training Effects on Athletic Performance in Youth Soccer Athletes: A Systematic Review. J Strength Cond Res. 2015 Aug;29(8):2351–60. [doi:10.1519/JSC.0000000000000877] [PMid:25756326]
15. Rössler R, Donath L, Verhagen E, Junge A, Schweizer T, Faude O. Exercise-based injury prevention in child and adolescent sport: a systematic review and meta-analysis. Sports Med. 2014 Dec;44(12):1733–48. [doi:10.1007/s40279-014-0234-2] [PMid:25129698]
16. Owen AL, Wong DP, Paul D, Dellal A. Effects of a periodized small-sided game training intervention on physical performance in elite professional soccer. J Strength Cond Res. 2012 Oct;26(10):2748–54. [doi:10.1519/JSC.0b013e318242d2d1] [PMid:23001394]
17. Halson SL. Monitoring Training Load to Understand Fatigue in Athletes. Sports Med. 2014;44(Suppl 2):139–47. [doi:10.1007/s40279-014-0253-z] [PMid:25200666]
18. Huxley DJ, O'Connor D, Healey PA. An examination of the training profiles and injuries in elite youth track and field athletes. Eur J Sport Sci. 2014;14(2):185–92. [doi:10.1080/17461391.2013.809153] [PMid:23777449]
19. Burgess DJ, Naughton GA. Talent development in adolescent team sports: a review. Int J Sports Physiol Perform. 2010 Mar;5(1):103–16. [doi:10.1123/ijspp.5.1.103] [PMid:20308701]
20. Bourdon PC, Cardinale M, Murray A, Gastin P, Kellmann M, Varley MC, et al. Monitoring Athlete Training Loads: Consensus Statement. Int J Sports Physiol Perform. 2017 Apr;12(Suppl 2):S2161–70. [doi:10.1123/IJSPP.2017-0208] [PMid:28463642]
21. Foster C, Boullosa D, McGuigan M, Fusco A, Cortis C, Arney BE, et al. 25 Years of Session Rating of Perceived Exertion: Historical Perspective and Development. Int J Sports Physiol Perform. 2021 May 1;16(5):612–21. [doi:10.1123/ijspp.2020-0599] [PMid:33508782]
22. Marynowicz J, Kikut K, Lango M, Horna D, Andrzejewski M. Relationship Between the Session-RPE and External Measures of Training Load in Youth Soccer Training. J Strength Cond Res. 2020 Oct;34(10):2800–4. [doi:10.1519/JSC.0000000000003785] [PMid:32773542]
23. Haddad M, Stylianides G, Djaoui L, Dellal A, Chamari K. Session-RPE Method for Training Load Monitoring: Validity, Ecological Usefulness, and Influencing Factors. Front Neurosci. 2017;11:612. [doi:10.3389/fnins.2017.00612] [PMid:29163016]
24. Foster C, Florhaug JA, Franklin J, Gottschall L, Hrovatin LA, Parker S, et al. A New Approach to Monitoring Exercise Training. The Journal of Strength & Conditioning Research. 2001 Feb;15(1):109–15. [doi:10.1519/00124278-200102000-00019] [PMid:11708692]
25. Hooper SL, Mackinnon LT. Monitoring overtraining in athletes. Recommendations. Sports Med. 1995 Nov;20(5):321–7. [doi:10.2165/00007256-199520050-00003] [PMid:8571005]
26. Green JM, McIntosh JR, Hornsby J, Timme L, Gover L, Mayes JL. Effect of exercise duration on session RPE at an individualized constant workload. Eur J Appl Physiol. 2009 Nov;107(5):501–7. [doi:10.1007/s00421-009-1153-z] [PMid:19680680]
27. Jesus RS de, Batista RÉS, Santos VME, Ohara D, Alves E da S, Ribeiro LFP. Exercise Duration Affects Session Ratings of Perceived Exertion as a Function of Exercise Intensity. Percept Mot Skills. 2021 Aug;128(4):1730–46. [doi:10.1177/00315125211018445] [PMid:34039119]
28. Fusco A, Knutson C, King C, Mikat RP, Porcari JP, Cortis C, et al. Session RPE During Prolonged Exercise Training. Int J Sports Physiol Perform. 2020 Feb 1;15(2):292–4. [doi:10.1123/ijspp.2019-0137] [PMid:31172830]
29. O'Connor PJ, Morgan WP, Raglin JS. Psychobiologic effects of 3 d of increased training in female and male swimmers. Med Sci Sports Exerc. 1991 Sep;23(9):1055–61. [doi:10.1249/00005768-199109000-00010]
30. Morgan WP, Costill DL, Flynn MG, Raglin JS, O'Connor PJ. Mood disturbance following increased training in swimmers. Med Sci Sports Exerc. 1988 Aug;20(4):408–14. [doi:10.1249/00005768-198808000-00014] [PMid:3173050]

31. Moalla W, Fessi MS, Farhat F, Nouira S, Wong DP, Dupont G. Relationship between daily training load and psychometric status of professional soccer players. Res Sports Med. 2016;24(4):387–94. [doi:10.1080/15438627.2016.1239579] [PMid:27712094]
32. Thorpe RT, Strudwick AJ, Buchheit M, Atkinson G, Drust B, Gregson W. Monitoring Fatigue During the In-Season Competitive Phase in Elite Soccer Players. Int J Sports Physiol Perform. 2015 Nov;10(8):958–64. [doi:10.1123/ijspp.2015-0004] [PMid:25710257]
33. Buchheit M, Racinais S, Bilsborough JC, Bourdon PC, Voss SC, Hocking J, et al. Monitoring fitness, fatigue and running performance during a pre-season training camp in elite football players. J Sci Med Sport. 2013 Nov;16(6):550–5. [doi:10.1016/j.jsams.2012.12.003] [PMid:23332540]