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The prevention of overtraining with the monitoring training loads: case of football

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Abstract: The aim of this paper is to use a training load quantification tool (RPE) to evaluate if the training load programmed by the coach is appropriate to the characteristics of these footballers. The study was conducted at the football section of the Sale Sports Association, Morocco, on a sample of 8 football players who practice in the club of the Association, aged between 18 and 21 years, the study was established during a mesocycle in a period from 18/03/2019 to 20/04/2019. For the quantification of the training load (TL) we chose the (RPE) tool, where each footballer must give his own perception of the effort felt in each training session, taking into consideration also the duration of the session. This will allow us to calculate the intensity of the session estimated, on a scale from 0 to 10. Based on the results of the quantification of training load for the 8 footballers, we note that in the majority of the cases, the acute load (AL) is higher than the chronic load (CL) at the end of each week. On the other hand, for the monotony index (MI) that provides information on the negative adaptations of training and overtraining, we note that it present a high value among the majority of footballers (1.8UA <MI <2.1UA). For the average of the ratio of the training load: acute/chronic, we note that for the first three footballers the training loads are higher compared to the others. The monitoring training load help to better conceptualize the adaptations of the athlete to the training, and also allows the prediction of the performance.

Key Words: Morocco, Training loads, Football, Injuries, Overtraining

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1. Introduction

Professional football, like any high-level sport, imposes significant training loads on the athlete. This solicitation can partly explain the high incidence of injuries reported in the literature [1]. However, the risk of injuries can be limited through prevention programs based on the proper training schedule. [2] Fatigue and poor recovery are two essential markers that the coach must consider in order to optimize performance, avoiding overtraining and injuries. [3] The monitoring of training loads is an essential tool for: determining the degree of adaptation of the athlete with the load programmed during the training, understanding the individual reactions to the program, and also for determining the state of fatigue, [4] which will allow the trainer to predict the recovery time necessary to minimize the risk of overtraining, leading in many cases to non-functional disease [5].

There are several ways to quantify the training load (internal or external), among these tools we quote those that correspond to the characteristics of the exercise (intensity, volume ...) [6] for example, the total distance covered in a race, the total training time and the percentage of a maximum repetition (MR), but also there are new technological tools such as accelerometer, GPS and power sensors [7]. Other types of tools make it possible to take into account the feeling of the athlete, otherwise known as the internal training charge, which represents all the acute and chronic adaptations of the body with respect to the external load [7]; like the RPE (Rate Perceived Exertion). The aim of this study is to use a training load quantification tool (RPE) developed by Borg in 1998 [8], to evaluate if the training load programmed by the coach is appropriate to the characteristics of these footballers, and also highlight the importance of using this tool in programming a tailored and specific training to prevent injuries or overtraining in general.

2. Material and methods:

2.1. Sample

The study was conducted at the football section of the Sale Sports Association, Morocco, on a sample of 8 football players who practice in the club of the Association, aged between 18 and 21 years, who play in the national championship in Morocco, this athletes were chosen according to precise standards (commitment, seriousness, tenure), the study was established during a mesocycle in a period from 18/03/2019 to 20/04/2019.

2.2. Protocol

For the quantification of the training load (TL) we chose the (RPE) tool, where each footballer must give his own perception of the effort felt in each training session, taking into consideration also the duration of the session. This will allow us to calculate the intensity of the session estimated, on a scale of 0 to 10, after asking the following question to the 8 athletes' after15 minutes of the session «How did you feel about the session?"

Based on the responses of each athlete on the feeling questionnaire, we can calculate at the following variables:

2.3. ALCL

The Ratio Acute Load/Chronic load [5] measures the relationship between acute load (load of the current week) and chronic load (average load of the last 4 weeks). The monitoring of the RCAC preserves the training load in the high load/low risk zone. When the ratio is too low (<0.8) or too high (≥ 1.5), the risk of injury increases significantly and the load needs to be adjusted.

2.4. Acute Charge (AC)

Represent the cumulative charge for a current week. Usually, the higher the acute load (compared to the chronic load), the more tired the athlete is. In some cases, the acute load can also be calculated over shorter periods.

2.5. Chronic load (CL)

Represents the weekly load (Load = duration x RPE) is the moving average of the last 4 weeks. Normally, the higher the chronic load, the more fit the athlete is.

2.6. Monotony

The Monotonic Index proposed by American scientist Dr. Carl Foster [9] measures the variation in daily workload during the week. A high training load related to a monotonicity index greater than 2 is a significant risk factor for injury, and health problems related to overtraining. [9]

2.7 Duration

Duration of the training session in (Min).

2.8. The training load (TL)

The training load in arbitrary units (AU) refers to the combination of sports and non-sport stressors (training, competition, work, social life, family, studies, etc.) which affect the athlete [10]. The workload can be divided into two types: external load and internal load.

2.9. Statistical analysis

The data entered and analyzed using Excel version 2016.

3. Results

3.1 Monitoring of training load for each footballer

Figures from 1 to 8 correspond to the evolution of the training load monitoring parameters for the 8 football players during a period of 29 days. The axis to the left corresponds to the Chronic load (CL), and the Acute Charge (TL) in (UA), and the second Vertical Axis to the right corresponds to the values of Monotonicity and the ALCL in UA.

According to figure 1, we see that in the first week the curve of the CL generally exceeds the curve of the AL, also in the second week, except that from the 12th until the 16th day, we notice that the AL is superior than the CL, and this is the case for the end of the 3rd and 4th week, which explains that at the end of each week the players and more and more tired, and risk of injuries.

The monotonicity index provides information on negative adaptations of training and overtraining, according to the figure we note that it is high in this athlete (1.8UA <MI <2.1UA). According to Figure 3, we notice for the third player, three periods of excessive fatigue, this is where the AL exceeds the CL, the first from the 4th until the 8th day of the first week, the second is from 12th at the 15th day, as well as the last is from the 18th to the 20th day. From Figure 3, the AL is the most dominant, since it appears from the 4th day of the first week to the middle of the second week, then it begins to decrease gradually, with an increase in the CL in the third and fourth week. From Figure 4 we note that the CL exceeds the AL in the beginning and the middle of the weeks, while the CL decreases in the weekend followed by an increase in the AL, as well a remarkable increase at the level of the ALCL in the 4th week, also a monotonic index very high (1.8 <MI <2.2). According to Figure 5, the fifth player had 4 training load peaks (CL), 7th, 14th, 21st and 28th. In subjects 6, 7 and 8 the AL, exceeds the CL at the end of each week.

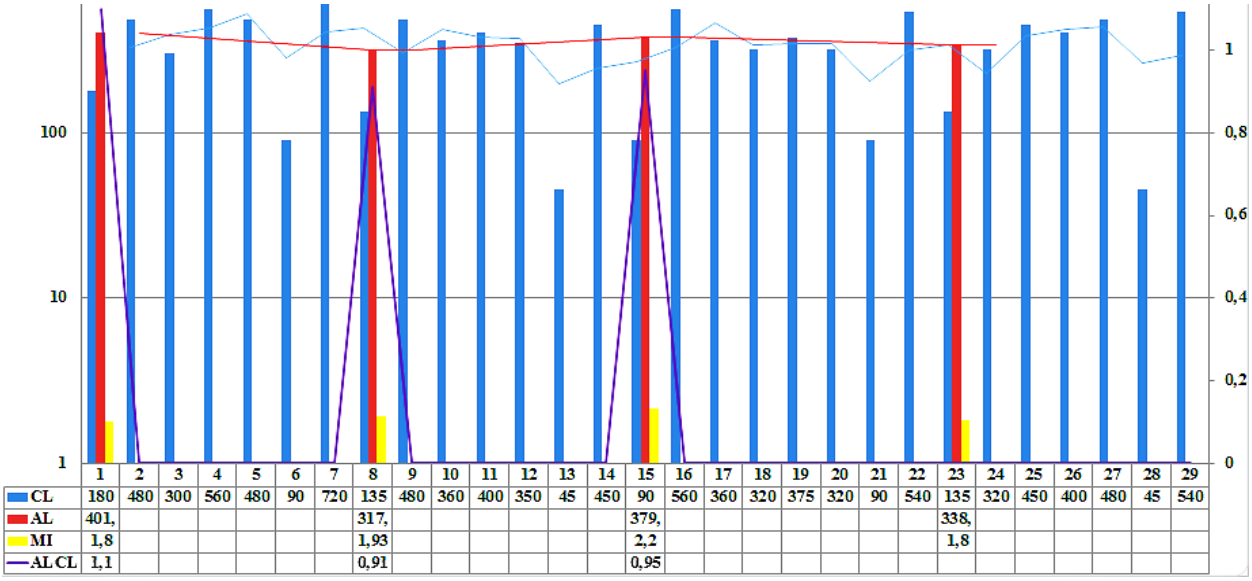
3.2 The comparison of the training loads of the 8 footballers over the four weeks

The figure below illustrates the sum of the training load observed for the 8 footballers over a period of 4 weeks. This type of presentation offers good visibility of the principle of progressivity of the load, which is a fundamental concept in order to increase the training load and minimizing the risk of injury.

For subject 1 and subject 2, we note that the succession of training loads is random; proving that the training program doesn't follow the principle of progressivity, for example for the subject 1 we see that the highest training load correspond to the first week.

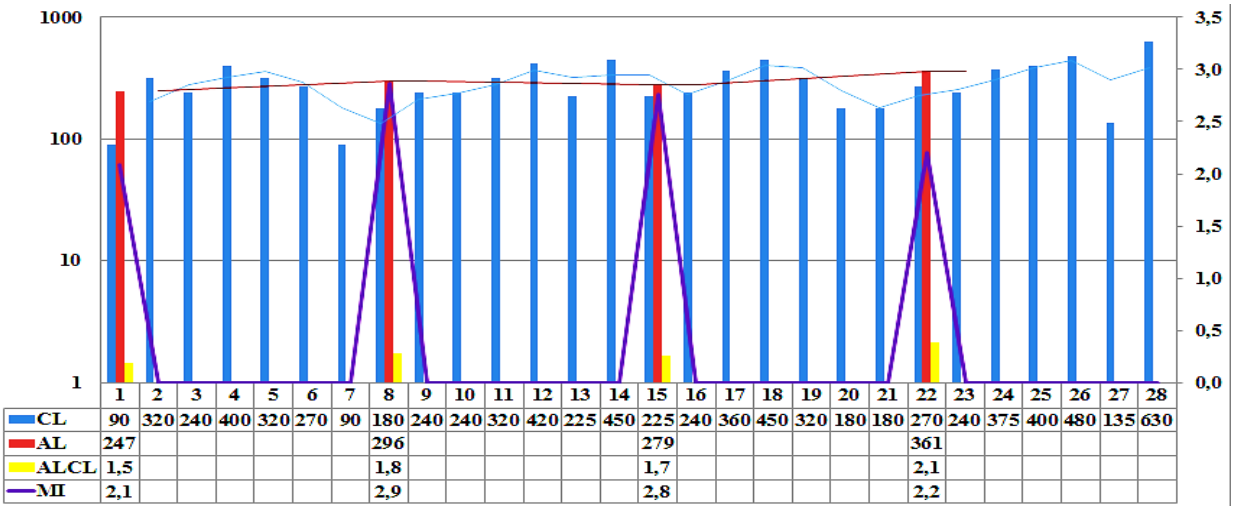
3.3 Comparison between the averages of the ratio (ALCL) over the 4 weeks

According to figure 10 which represent the average of the ratio of the training load: acute / chronic, we note that for the first three footballers the training loads are higher compared to the others.



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
CL	180	480	300	560	480	90	720	135	480	360	400	350	45	450	90	560	360	320	375	320	90	540	135	320	450	400	480	45	540
AL	401,							317,							379,								338,						
MI	1,8							1,93							2,2								1,8						
ALCL	1,1							0,91							0,95														

Figure 1. Monitoring training load for the footballer 1.



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
CL	90	320	240	400	320	270	90	180	240	240	320	420	225	450	225	240	360	450	320	180	180	270	240	375	400	480	135	630
AL	247							296							279							361						
ALCL	1,5							1,8							1,7							2,1						
MI	2,1							2,9							2,8							2,2						

Figure 2. Monitoring training load for the footballer2.

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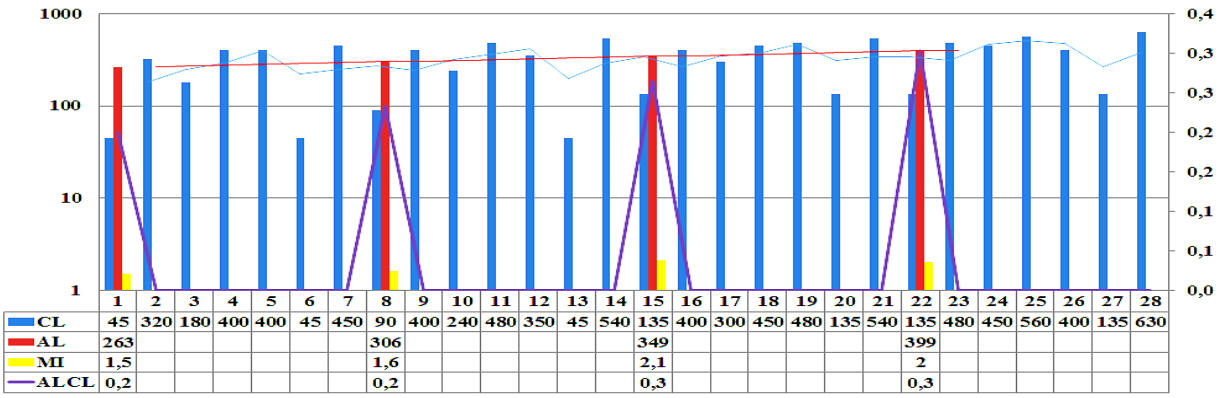
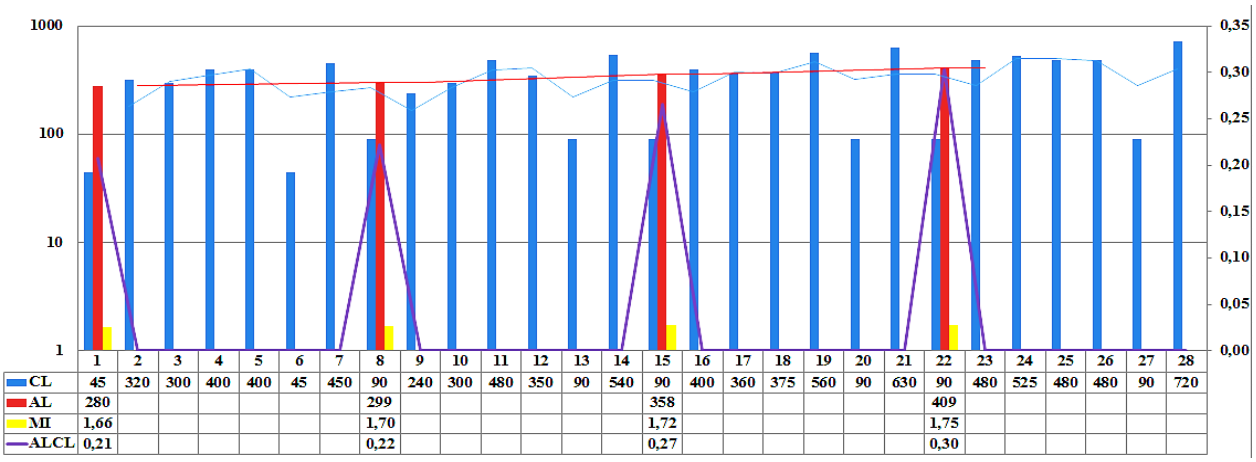


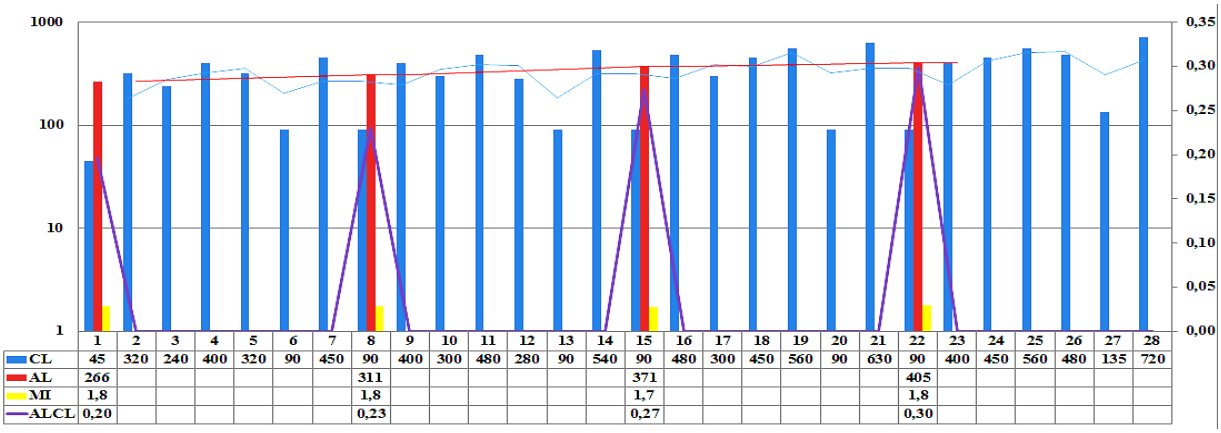
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
CL	45	320	180	400	400	45	450	90	400	240	480	350	45	540	135	400	300	450	480	135	540	135	480	450	560	400	135	630
AL	263							306							349							399						
MI	1,5							1,6							2,1							2						
ALCL	0,2							0,2							0,3							0,3						

Figure 3. Monitoring training load for the footballer 3.



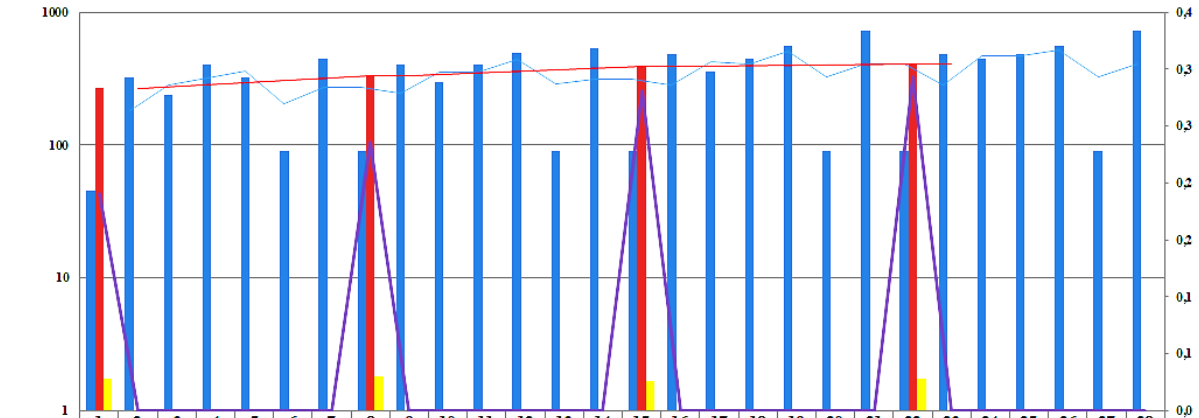
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
CL	45	320	300	400	400	45	450	90	240	300	480	350	90	540	90	400	360	375	560	90	630	90	480	525	480	480	90	720
AL	280							299							358							409						
MI	1,66							1,70							1,72							1,75						
ALCL	0,21							0,22							0,27							0,30						

Figure 4. Monitoring training load for the footballer 4.



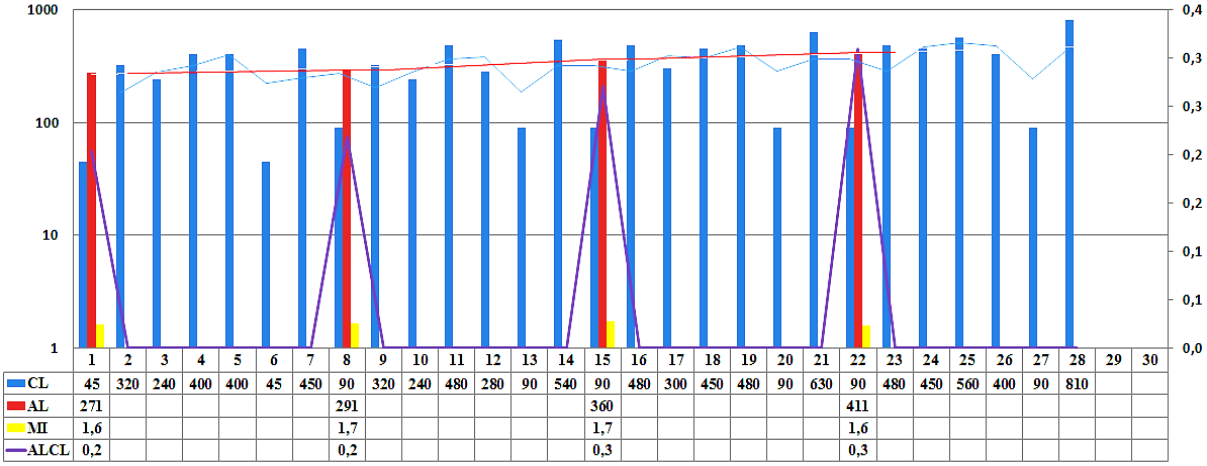
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
CL	45	320	240	400	320	90	450	90	400	300	480	280	90	540	90	480	300	450	560	90	630	90	400	450	560	480	135	720
AL	266							311							371							405						
MI	1,8							1,8							1,7							1,8						
ALCL	0,20							0,23							0,27							0,30						

Figure 5. Monitoring the training load for the footballer 5.



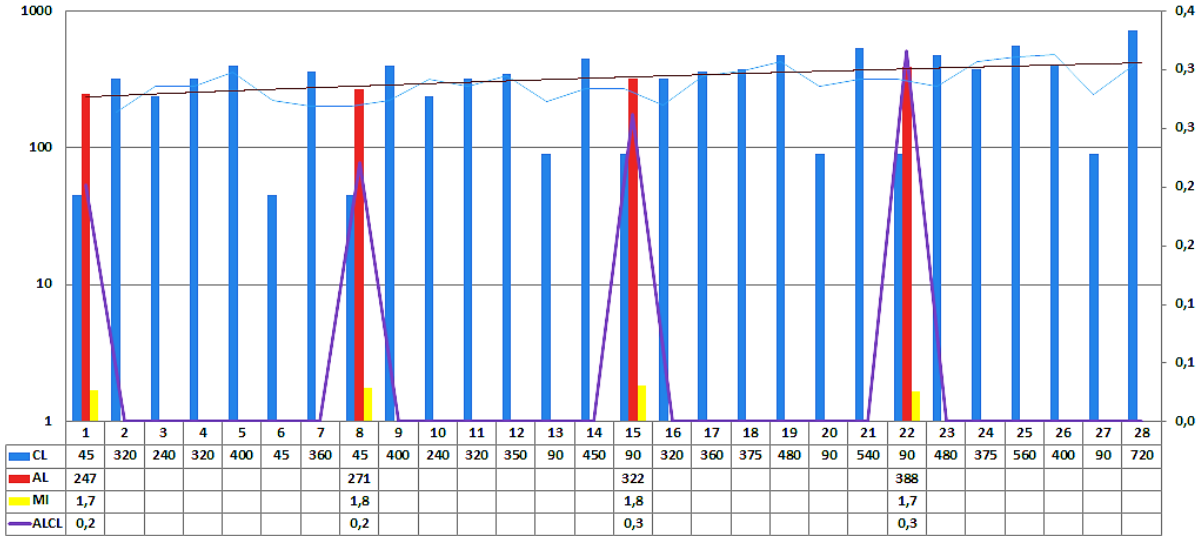
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
CL	45	320	240	400	320	90	450	90	400	300	400	490	90	540	90	480	360	450	560	90	720	90	480	450	480	560	90	720
AL	266							330							393							410						
MI	1,8							1,8							1,7							1,7						
ALCL	0,2							0,2							0,3							0,3						

Figure 6. Monitoring the training load for the footballer 6.



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
CL	45	320	240	400	400	45	450	90	320	240	480	280	90	540	90	480	300	450	480	90	630	90	480	450	560	400	90	810		
AL	271							291							360							411								
MI	1,6							1,7							1,7							1,6								
ALCL	0,2							0,2							0,3							0,3								

Figure 7. Monitoring the training load for the footballer 7.



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
CL	45	320	240	320	400	45	360	45	400	240	320	350	90	450	90	320	360	375	480	90	540	90	480	375	560	400	90	720
AL	247							271							322							388						
MI	1,7							1,8							1,8							1,7						
ALCL	0,2							0,2							0,3							0,3						

Figure 8. Monitoring the training load for the footballer 8.

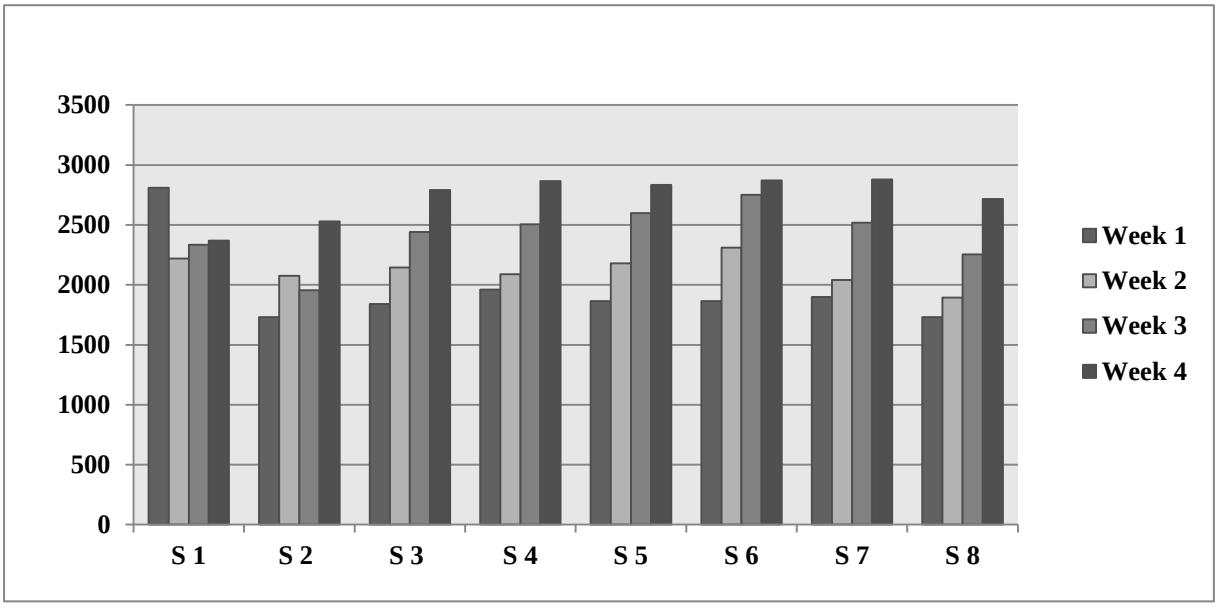


Figure 9. The sum of the training loads of the 8 footballers over 4 weeks.

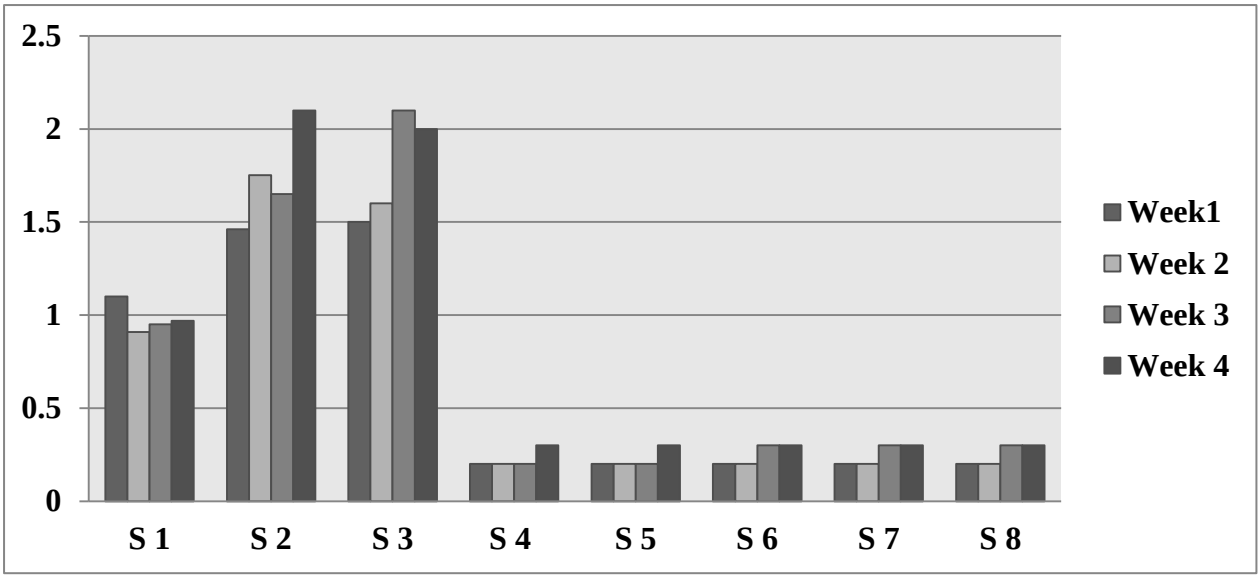


Figure 10. Comparison of the averages of the ratio of acute / chronic load over 4 weeks for the 8 footballers.

4. Discussion

Many Many studies have emphasized the importance of quantifying the training load to improve athletic performance [11-12-13-14-15-16-17], and this was confirmed by the results of our study which shown that the RPE method is involved in the detection of the imperfections of a training program, especially those related to the state of freshness and fatigue that have a direct impact on the appearance of injuries during a football mesocycle.

Based on the results of the quantification of training load for the 8 footballers according to the figures from 1 to 8, we note that in the majority of the cases, the AL is higher than the CL at the end of each week, which explains that at the end of each week the players and more and more tired, which makes him susceptible to develop an injury [5-18], and this result confirms that the training program delivered by the coach is not adapted to the athletes' requirements.

On the other hand, for the index of monotony that provides information on the negative adaptations of training and overtraining, we note that it present a high value among the majority of footballers (1.8UA <MI <2.1UA), which, according to Foster, explains that a monotonicity index superior than 2 represents a significant risk factor for injury, and health problems related to overtraining [7].

According to figure 9, we noted that for subject 1 and subject 2, the succession of training loads is random, for example for the subject 1 the highest training load during the mesocycle appears in the first week, and this could be explained by the fact that the trainer did not take into account during the training program the principle of progressivity [10-5]. The risk of injury is minimized when load variations from one week to another remain less than 10% (8% risk of injury). On the other hand, with weekly variations in the order of 15-20%, the risk of injury increases between 20-25% and increases gradually to reach nearly 50% when the variation of the load is massive [10]

According to figure 10, for the first 3 footballers, the load is higher compared to the others (0.9 <ALCL<2.1), which explains why they are more exposed to injuries, same result for the other subjects because their RCAC is less than 0.8 which means that these footballers are not in a state of freshness which is defined by a ratio ALCL between 0, 8 and 1 [5].

Based on several studies on football [19, 20], which showed that when CE values during pre-competitive periods reach values between (2300-2900) AU, there is a strong possibility that players are exposed to injuries, feelings of fatigue and especially to a decline in performance during the competition period.

Finally, since the RPE method is an effective evaluation tool for the monitoring training loads, it has its limitations, and takes into account in a large part the intuition of each participant about his

training. However, an inexperienced athlete will find it more difficult to estimate the exact difficulty experienced during training and games [21].

5. Conclusion

The monitoring training load help to better conceptualize the adaptations of the athlete to the training, and also allows the prediction of the performance. Our study has shown that the use of the RPE method not only prevents injuries, but also better planned training sessions according to pre-established requirements, and to avoid the improvisation of loads randomly. And from here another study according to a longitudinal approach is desirable in order to study the impact of the quantification of the training load on the performance.

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Conflict of interest

None of the authors have any conflicts of interest to declare.

Informed consent

All participants gave written informed consent to participate in this study.

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