Scientific Review of Physical Culture
e-ISSN 2658-0802

Evaluation of physical fitness and the occurrence of delayed myalgia syndrome in relation to the use of wellness treatments among football players

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Authors' Contribution:
A - Study Design; **B** - Data collection;
C - Statistical analysis; **D** - Data interpretation;
E - Manuscript Preparation; **F** - Literature search;
G -Funds Collection

SRPC-ID:	SRPC13-3-2022	Published online:	2-08-2023	ORIGINAL ARTICLE

Abstract:

Introduction: Achieving top performance in sport is possible by maximising the factors influencing success. With the development of sport, motor preparation starts to play a decisive role. Monitoring the state of health and psychophysical capabilities of athletes helps to achieve success. In order to positively influence the regeneration of the organism after exertion, athletes use biological regeneration treatments.
The aim of the study: The aim of this study was to evaluate physical fitness and the occurrence of delayed myalgia syndrome in relation to the use of wellness treatments among football players.
Material and method: The research was carried out in the form of a questionnaire, as well as double testing of selected components of physical fitness.
Research results: Respondents using wellness treatments experienced less muscle soreness. There was no correlation between the use of wellness treatments and psychophysical condition. In the conducted fitness tests better results were achieved by the control group, a greater progress was noted among the players using wellness treatments.
Conclusion: The results obtained suggest that the use of wellness treatments may accelerate the recovery process in athletes. It is difficult to determine the effect of treatments on the psychophysical state of athletes.

Keywords: football, biological regeneration, health

Introduction

Nowadays, the results of athletes from all over the world are incomparably better than the results of athletes of the past. This is evidenced by records that are regularly broken in individual disciplines. Players, thanks to their general development, have the opportunity to achieve results that were out of reach a dozen or so years ago. There are many factors that affect such rapid development in sport. The key issue is proper motor preparation. Proper training planning, skilful selection of loads, analysis of training cycles, monitoring the health and condition of players play a decisive role. Achieving higher results during the training process and the best sports results, without negative effects on the health of the athlete, seems to be impossible without the use of post-workout restitution treatments. Fatigue is a physiological phenomenon whose task is to protect the body. Thanks to it, our body knows when the effort should be interrupted without leading to health complications. Fatigue is not just the result of hard work. It can also appear as a result of insufficient sleep or chronic fatigue syndrome. Fatigue leads to a decrease in the level of strength and the speed of muscle contraction. The second group of effects of fatigue are muscle pain, dizziness or nausea. There are two types of fatigue. Peripheral fatigue may be the result of changes developing in the muscles used during exercise. The second type is central fatigue, which is caused by changes in the central nervous system [1].

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Training load monitoring has been the subject of many scientific papers in recent years. This helps trainers to individually write, control, analyze, customize and program training sessions. It can be stated that the most important indicators that are used to monitor the training load were measurements of resting heart rate before training, heart rate reserve during training, sinus rhythm variability and urinary indicators, showing the hydration status of players [2]. The condition for proper training planning is therefore to have adequate knowledge about the work done so far, the body's reactions to the given effort, or the direction of adaptive changes to be caused. There are many methods to describe training loads – from completely descriptive methods that take into account only the content of the training, to extensive analyzes [3].

Biological regeneration also plays a very important role in the body of players. It consists in the intended acceleration of physiological leisure processes. For these purposes, available means are used, which can be divided into artificial and natural. Artificial means are physiotherapeutic treatments, while natural ones are proper rest or proper sleep. Physiotherapeutic agents are used in post-workout restitution processes, as well as in therapeutic rehabilitation. Treatments are mainly directed to professional athletes. Nevertheless, the positive effects of treatments can be observed in people who practice sports recreationally, as well as for those tired of everyday activities, such as professional work or duties at home and in its surroundings.

Biological regeneration is a process that can be used by everyone, even people who do not practice sports [3]. By analysing and properly selecting biological regeneration agents, we increase the chance of constant improvement of sports results or, in the case of amateurs – improvement of well-being [4]. The sphere of biological regeneration activity, which is cooperation with the training process, is aimed at enriching and supplementing training methods, while increasing the effectiveness of the physiological capabilities of the athlete's body. Wellness measures are used, among others, during the starting preparations of competitors, for achieving their best condition mental and physical during the start period [5].

Football is currently one of the most popular sports. It is grown all over the world. The level of fitness preparation of players increases with the acceleration of the pace of the game, improvement of running achievements or the number of kilometers run during one match. Regardless of the conditions, during the game the players use all elements of physical fitness. Players are required to be very proficient in terms of general and special preparation. General preparation is designed to develop the movement potential of the athlete, as well as to shape the mechanisms of efforts that do not have a direct impact on the form during the start period. Development of a special nature improves the complex of qualities that are necessary in a particular sports discipline, in this case these are all football skills. We can include m.in the technique of hitting or driving the ball. Highly developed motor dispositions such as endurance, speed, strength, flexibility or coordination affect higher level of special skills - Football [6]. Based on these data, it can be seen that motor preparation in footballers should be based on the formation of endurance efforts. During such training, long-term loads of uniform intensity should be limited, as well as from time to time take part in biological regeneration treatments [7].

The aim of the study

The aim of the study was to determine the attempt to assess the differences in biological regeneration of football players on their fitness results and on the occurrence of delayed muscle soreness syndrome when using biological regeneration treatments. Research question:

1. What were the differences in the results of fitness tests between the group of respondents using biological regeneration treatments and the group in which they were not?

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2. Will athletes using wellness treatments record greater progress in fitness achievements than athletes who do not use these treatments?
3. Will there be differences between the study groups in the context of DOMS feeling?
4. Will the group of respondents using wellness treatments rate their psychophysical condition higher?

Material and methods

During the preparatory and starting periods, preceding the spring round of the 2020/21 season in the 4th Podkarpackie league, research was carried out among the players of the JKS Jarosław football team. The study group finally included 19 players aged 16 to 42. Initially, the team was divided into two groups. The first of them, consisting of 10 people, received guidelines for the use of biological regeneration treatments. The competitors used the Finnish dry sauna twice a week, each spending two sessions of 12 minutes at a temperature of 90-100 degrees Celsius, at a humidity level of about 15%. Between sessions, the players cooled down the body and rested for 15 minutes. Sauna treatments took place on Wednesdays and Saturdays. The choice of dates was matched to the team's training plan. On Thursdays, the players did not train, Sunday was also free, which allowed to take full advantage of the sauna's impact on regeneration. On other days, the players trained on the pitch, on Saturdays they played friendly matches or internal games. In addition to the sauna, the treatment group used cryotherapy twice a week, which consisted of spending three 2-3 minute cycles in a bathtub filled with cold water and ice cubes. Treatments were carried out on Tuesdays and Fridays. In addition, the players from the first group had to perform a minimum of 8 minutes of self-massage of the lower parts of the body on the roller before and after each training. The second group, which included the other 9 players, participated in training on the same principles and loads, but did not benefit from wellness treatments.

In order to check the fitness disposition of the players, both groups were examined twice. The first test session was conducted at the very beginning of the three-week observations, the second on the last day. Twice the research was organized on the football field in Jarosław. The original set included 4 tests examining various components of physical fitness. The first of them was a shuttle run on time, the competitors had to overcome 4 twenty-meter sections marked with cones on the football field. The second test was the long jump from the place of both hands. The competitors approached the attempt twice, only a better result was recorded. The next task to perform was juggling the ball, only with the weaker foot. In this competition, the competitors also had two attempts, and only a better result was saved. The test began with throwing the ball with both hands, directly into the juggling, ended when the ball came into contact with the ground, or a different part of the body than the weaker foot of the player. The last test was to examine the accuracy of players in strikes on small goals measuring 120cmx80cm from a distance of 15m. Players hit alternately to two goals. Three times to one with the left leg, three times to the other with the right leg. After each hit, the subjects had to overcome the distance to the bollard 5m away from the middle balls, return and hit another ball. The competitors had a maximum of one minute to complete the entire task.

In order to monitor the well-being of the athletes, as well as their reaction to training loads in both groups, Hooper's questionnaires were carried out. Before each training, the players answered 4 questions concerning: In order to monitor the well-being of the athletes, as well as their reaction to training loads in both groups, Hooper's questionnaires were carried out. Before each training, the players answered 4 questions concerning:

- sleep quality on the night before the day of the study
- stress assessment
- muscle fatigue
- muscle soreness (DOMS)

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Each parameter was measured separately and answers were given only subjectively. The grading scale included seven levels:

1. Very low
2. Low
3. Average
4. Endorsement
5. Very good
6. Exceptionally good

Results

The results of the research conducted twice on the players of the fourth league football club JKS Jarosław allowed to determine whether there are significant differences in fitness results between the group using biological regeneration treatments and the group in which the players were not subjected to the above-mentioned post-workout regeneration measures.

Table 1 shows the numerical characteristics of the pendulum run for the wellness group. The analysis showed that the competitors during the second measurement obtained a shorter time in the shuttle run by 0.16 s. The longest time of the shuttle run test was observed during the first measurement and it was 18.69 s. A smaller dispersion of results was obtained during the second attempt, where the coefficient of variation is 3.97%. The differences in results between the two measurements are not statistically significant (p = 0.068).

Table 1. Characteristics of the shuttle run of the wellness group in the first and second measurement
Source: Own elaboration

Shuttle (S)- wellness									
Measurement	**n**	**x**	**Me**	**min**	**max**	**SD**	**V**	**d (II-I)**	**p**
I	10	17.50	17.53	16.22	18.69	0.78	4.45	– 0.16	0.068
II	10	17.34	17.42	16.02	18.55	0.69	3.97		

n- number of subjects, x – arithmetic mean, sd – standard deviation, Me – median, min – minimum value, max – maximum value, V – coefficient of variation, d – difference between the second and first measurement α=0.05, p– test probability

The characteristics of the pendulum run for the control group are shown in Table 2. The analysis shows that the control group obtained a shorter time in the pendulum run during the second measurement (17.14 s). The shortest time was also observed during the second measurement (16.12 s). A higher coefficient of variation was recorded in the first attempt and amounts to 4.20%. During the second attempt, the coefficient of variation decreased to 4.07%. No statistically significant differences were observed between the first and second measurements (p=0.109).

Table 2. Characteristics of the pendulum run of the control group in the first and second measurement
Source: Own elaboration

Shuttle run (S)- control group									
Measurement	**n**	**x**	**Me**	**min**	**max**	**SD**	**V**	**d (II-I)**	**p**
I	9	17.25	17.14	16.22	18.55	0.72	4.20	–0.11	0.109
II	9	17.14	17.21	16.12	18.52	0.70	4.07		

The differences between the wellness and control groups in the first and second measurements are shown in Table 3. The analysis shows that the control group achieved a 0.25 s shorter time in the pendulum run in the first measurement. In contrast, the

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difference between the groups is not statistically significant (p = 0.482). In the second measurement, the difference was 0.2 s and is also not statistically significant. Table 3.

Table 3. Characteristics of the differences in the pendulum gear in the first and second measurement
Source: Own elaboration

Shuttle (s)		
Measurement	**d(OB-K)**	**p**
I	0.25	0.482
II	0.20	0.534

d(OB-K) - the difference between the wellness group and the control group

Table 4 shows the numerical characteristics of the long jump from the site for the wellness group. The analysis showed that the competitors during the second measurement obtained a greater distance in the long jump by 0.30 cm. The longest distance of the long jump attempt was observed during the second measurement and it was 243.00 cm. A smaller dispersion of results was obtained during the second attempt, where the coefficient of variation is 3.99%. The differences in the results between the two measurements are not statistically significant (p = 0.859).

Table 4. Characteristics of the long jump from the place of the wellness group in the first and second measurement
Source: Own elaboration

Long jump (cm) - Wellness									
Measurement	**n**	**x**	**Me**	**min**	**max**	**SD**	**V**	**d (II-I)**	**p**
I	10	227.20	231.00	209.00	241.00	10.72	4.72	0.30	0.859
II	10	227.50	225.50	217.00	243.00	9.07	3.99		

Table 5 shows the numerical characteristics of the long jump from the control group. The analysis showed that the competitors during the second measurement obtained a lower average distance in the long jump by 1 cm. The longest distance of the long jump attempt was observed during the first measurement and it was 243.00 cm. Less dispersion of results was obtained during the second attempt, where the coefficient of variation is 2.70%. The differences in the results between the two measurements are not statistically significant (p = 0.516).

Table 5. Characteristics of the pendulum run of the control group in the first and second measurement
Source: Own elaboration

Long jump (cm) - Control group									
Measurement	**n**	**x**	**Me**	**min**	**max**	**SD**	**V**	**d (II-I)**	**p**
I	9	231.00	230.00	222.00	243.00	6.24	2.70	–1.00	0.516
II	9	230.00	231.00	216.00	240.00	7.12	3.10		

The differences between the wellness group and the control group in the first and second measurements are shown in Table 6. The analysis shows that the control group obtained a greater distance in the first measurement by 3.80 cm, while in the second sample the difference was 2.50 cm, also in favor of the control group. The differences in the two measurements are not statistically significant.

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Table 6. Characteristics of the differences in the long jump from the place in the first and second measurement
Source: Own elaboration

Long jump (cm)		
Measurement	**d(OB-K)**	**p**
I	–3.80	0.366
II	–2.50	0.516

Table 7 shows the numerical characteristics of the juggling test for the wellness group. The analysis showed that the competitors during the second measurement obtained a better result by 5.20 repetitions. The highest score of raises was observed during the second measurement and it was 51. A smaller dispersion of results was obtained during the second attempt, where the coefficient of variation is 41.2%. The differences in results between the two measurements are statistically significant (p = 0.0001).

Table 7. Juggling characteristics of the wellness group in the first and second measurement
Source: own elaboration

Juggling - wellness									
Measurement	**n**	**x**	**Me**	**min**	**max**	**SD**	**V**	**d (II-I)**	**p**
I	10	22.70	22.00	7.00	46.00	11.38	50.14	5.20	0.0001*
II	10	27.90	25.50	14.00	51.00	11.49	41.20		

*- statistical significance at the level of α = 0.05

Juggling characteristics for the control group are shown in Table 8. The analysis shows that the control group obtained a better result during the second measurement by 6.56 repeats. The best result was also observed during the second measurement (62.00). A higher coefficient of variation was recorded in the second attempt and amounts to 56.52%. During the second attempt, the coefficient of variation decreased to 26.05%. No statistically significant differences were observed between the first and second measurements (p = 0.257).

Table 8. Juggling characteristics of the control group in the first and second measurement
Source: own elaboration

Juggling - control group									
Measurement	**n**	**x**	**Me**	**min**	**max**	**sd**	**V**	**d (II-I)**	**p**
I	9	19.67	19.00	12.00	27.00	5.12	26.05	6.56	0.257
II	9	26.22	23.00	13.00	62.00	14.82	56.52		

The differences between the wellness and control groups in the first and second measurements are shown in Table 9. The analysis shows that the control group obtained a better result in juggling by 3.03 repetitions in the first measurement. However, the difference between the groups is not statistically significant (p = 0.473). In the second measurement, the difference was 1.68 repeats and is also not statistically significant.

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Tabela 9. Characteristics of the differences in the Juggling from the place in the first and second measurement
Source: Own elaboration

Juggling		
Measurement	**d(OB-K)**	**p**
I	3.03	0.473
II	1.68	0.785

Table 10 shows the numerical characteristics of strokes per goal for the wellness group. The analysis showed that the players during the second measurement obtained a better result by 0.50 hits. The highest result was observed during the second measurement and it was 6 hits. A smaller dispersion of results was obtained during the first trial, where the coefficient of variation is 24.18%. The differences in the results between the two measurements are not statistically significant (p = 0.138)

Table 10. Characteristics of the impact on goal of the wellness group in the first and second measurement
Source: own elaboration

Goal strike – wellness									
Measurement	**n**	**x**	**Me**	**min**	**max**	**sd**	**V**	**d (II-I)**	**p**
I	10	3.30	3.00	2.00	5.00	0.95	28.75	0.50	0.138
II	10	3.80	4.00	3.00	6.00	0.92	24.18		

Table 11 shows the numerical characteristics of shots on goal for the control group. The analysis showed that the players during the second measurement obtained a better result by 0.67 hits compared to the results during the first attempt. The best result was repeated in both attempts and was 5 hits. A smaller dispersion of results was obtained during the first trial, where the coefficient of variation is 19.02%. The differences in results between the two measurements are statistically significant (p = 0.022).

Table 11. Characteristics of the impact on the goal of the control group in the first and second measurement
Source: own elaboration

Goal strike - control group									
Measurement	**n**	**x**	**Me**	**min**	**max**	**sd**	**V**	**d (II-I)**	**p**
I	9	3,44	3,00	2,00	5,00	0,88	25,60	0,67	0,022*
II	9	4,11	4,00	3,00	5,00	0,78	19,02		

*- statistical significance at the level of α=0.05

The differences between the wellness and control groups in the first and second measurements are shown in Table 12. The analysis shows that the wellness group scored 0.14 worse in shots on goal in the first measurement. However, the difference between the groups is not statistically significant (p = 0.736). In the second measurement, the difference was 0.31 s and is also not statistically significant (p = 0.440).

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Table 12. Characteristics of the differences in impact on goal in the first and second measurement
Source: own elaboration

Strikes on goal		
Measurement	**d(OB-K)**	**p**
I	–0,14	0,736
II	–0,31	0,440

By analysing the questionnaires systematically completed by the players on an ongoing basis, it was possible to monitor their well-being and the body's reaction to training loads. Thanks to the comparison of both groups, it was realistic to determine whether there were differences in the well-being of players from the biological regeneration group and the control group. In the case of the wellness group, the highest value was obtained during the first three days of measurement, where the indicator fluctuated between 19 and 20. In the next measurement, it dropped significantly. In the control group, the highest value was recorded on the first day, which amounted to just over 20. The lowest value was recorded by both groups on March 15, in the wellness group a similar value was obtained a week earlier. Differences in sleep quality between groups are not statistically significant ($p = 1.000$).

In the next activity, changes in sleep quality during subsequent days were checked for the control group and the group using biological regeneration. For both groups, the highest value was obtained on the first day of measurement. The control group obtained a value close to 6.6, while the wellness group obtained a value of 6.3. The lowest value was obtained by the control group on March 10 and March 19, where the sleep quality rating was below 4.4. The wellness group had the lowest sleep quality rating on March 12 (4.5). Differences in sleep quality between groups are not statistically significant ($p = 0.659$).

Changes in fatigue assessments for individual days for the control group and the wellness group were then examined. In both groups, the highest value was recorded on March 17, in the wellness group the result was also high a week earlier. The control group obtained the highest value close to 5.1, while the wellness group obtained 5.35. The lowest value was obtained by the control group on March 8 and 15, where the fatigue level scores were 3.0 and about 2.6. The wellness group had the lowest fatigue level rating on March 15 (2.8). Differences in fatigue levels between groups are not statistically significant ($p = 0.659$).

Changes were also observed for assessments of perceived stress levels during consecutive days for the control group and the wellness group. In the control group, the highest value was recorded on March 3 (5.45), and in the wellness group it took place on March 5 (5.6). The lowest value of the wellness group was achieved on March 15 and it was the only result below 3.0. The control group had the lowest stress level score on March 17, with a value of 3.3 on that day. Differences in perceived fatigue between groups are not statistically significant ($p = 0.216$).

Subsequently, changes were also included to assess the perception of Delayed Muscle Pain Syndrome for individual days for both groups. In the control group, the lowest value was recorded on March 15 and was about 2.6. In the wellness group, the lowest marks appeared on March 8 and also on March 15. A similar situation in both groups occurred on the first day of measurements, where the highest scores were achieved, both above 5.0. Differences in DOMS perception between groups are not statistically significant ($p = 0.791$).

Discussion

The study group consisted of 19 active players of the fourth league football team, aged 16 to 42. The division of competitors into two groups (with biological regeneration

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and control) was assigned in alphabetical order before the first measurements. Two fitness tests allowed to compare the fitness achievements of athletes assigned to research groups among themselves, as well as to compare average results between two groups. When analysing the test results, it was taken into account whether there was a clear progression in the wellness group in the ratio of results from the second measurements to the results from the first trials. Then, the progress of the wellness group was compared to the group in which the treatments were not used. Players of both groups regularly proceeded to fill out the Hooper questionnaire, thanks to which it was possible to monitor the subjective assessments of the players, in terms of their perception of such aspects as: sleep quality, fatigue level, stress and DOMS during individual training days. The analysis of individual components allowed to compare how the players in both groups coped with the training loads, as well as whether the wellness treatments clearly influenced the subjective assessments of the players of their well-being.

Authors R. Akenhead and G. Nassis in their work on training loads, carried out in eighty-two high-level football clubs, described methods for monitoring sports achievements. The analysis of the studies allowed to estimate that the differences in the expected and actual effectiveness of monitoring were 20% for the improvement of results. Based on the results obtained, the authors concluded that future approaches should critically assess the usefulness of current monitoring tools and examine methods to reduce the identified barriers to effectiveness[8].

Błażej Stankiewicz and Jakub Środa in research conducted on a group of players of the fourth league team "Grom Osie" received results that proved better results of fitness results at the end of the preparatory period than at its beginning. In their work, the authors conducted research m.in on the basis of the "Rast" test[9].

In the work "The effect of deep massage on the quadriceps muscle of football players, in isokinetic and thermal imaging studies" it was shown that the use of deep massage elements has positive effects on the musculoskeletal system of players, m.in. in relation to speed and strength parameters[10].

The authors of Biesiada and Dobosiewicz in their work, describing tests based on the state of mood of the respondents, mentioned: Profile of Mood State (POMS), Recovery-Stress Questionnaire for Athletes (RestQ- Sport), Daily Analysis of Life Demands of Athletes (DALDA). In all of these questionnaires, the state of perceived stress is also examined, which shows that mood changes intertwine with physiological changes and changes in sports form[11].

The authors Hooper and Mackinnom stated that the overtraining monitoring program can be considered part of effective, professional management of athletes during intense training. However, the most appropriate tools for such a program are still debatable. Comprehensive physiological tests have not been shown to be better than non-invasive and less expensive psychological tests or self-analysis using simple questionnaires or diaries. The latter two methods provide assessment results faster, but they have the disadvantage of being able to distort the response by the athlete. Currently, it seems that conscientious self-analysis performed by an athlete is the most effective method of monitoring overtraining[12].

During studies of the effects of stress on professional players, the results revealed that Brazilian professional footballers experience a variety of stressful situations. These events are often the result of environmental requirements and can affect the performance of the work performed by the athlete, as they are perceived as eustress or anxiety. Some of these stressful situations are inherent in sport and adhere to the sports system or environment. The coach's pressure to win and conflicts with his teammates are examples of stressors in sports. Family problems and disputes with the press or fans are examples of external stressors[13].

It is obvious that the level of pressure felt by players at the IV level of the Polish league is far from professional players in the best leagues in the world. However, it is possible to see common elements in both cases, where the game is played for victory and

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during failures or weaker disposition during the match or even training, the player is in stressful situations.

Conclusion

The study group consisted of 19 active players of the fourth league football team, aged 16 to 42. The division of competitors into two groups (with biological regeneration and control) was assigned in alphabetical order before the first measurements. Two fitness tests allowed to compare the fitness achievements of athletes assigned to research groups among themselves, as well as to compare average results between two groups. When analysing the test results, it was taken into account whether there was a clear progression in the wellness group in the ratio of results from the second measurements to the results from the first trials. Then, the progress of the wellness group was compared to the group in which the treatments were not used. Players of both groups regularly proceeded to fill out the Hooper questionnaire, thanks to which it was possible to monitor the subjective assessments of the players, in terms of their perception of such aspects as: sleep quality, fatigue level, stress and DOMS during individual training days. The analysis of individual components allowed to compare how the players in both groups coped with the training loads, as well as whether the wellness treatments clearly influenced the subjective assessments of the players of their well-being.

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During studies of the effects of stress on professional players, the results revealed that Brazilian professional footballers experience a variety of stressful situations. These events are often the result of environmental requirements and can affect the performance

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of the work performed by the athlete, as they are perceived as eustress or anxiety. Some of these stressful situations are inherent in sport and adhere to the sports system or environment. The coach's pressure to win and conflicts with his teammates are examples of stressors in sports. Family problems and disputes with the press or fans are examples of external stressors[13].

It is obvious that the level of pressure felt by players at the IV level of the Polish league is far from professional players in the best leagues in the world. However, it is possible to see common elements in both cases, where the game is played for victory and during failures or weaker disposition during the match or even training, the player is in stressful situations.

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