MINISTERUL EDUCAȚIEI
UNIVERSITATEA NAȚIONALĂ DE EDUCAȚIE FIZICĂ ȘI SPORT DIN BUCUREȘTI
ȘCOALA DOCTORALĂ

RESEARCH REGARDING THE INTEGRATED PHYSICAL TRAINING AS A CONDITION OF TRAINING MANAGEMENT EFFICIENCY TO INCREASE EXERCISE CAPACITY
ABSTRACT
DOCTORAL THESIS

SCIENTIFIC COORDINATOR:
PROF. UNIV. PHD. CORINA ȚIFREA

PHD. CANDIDATE:
ZAHARIA GABRIEL

BUCHAREST
2023

ABSTRACT
Keyword: integrated physical training; football;

The science of sports training, especially at the elite level, requires the application of appropriate physiological knowledge specific to a particular sport. In our opinion, contemporary sports training relates to two aspects: (i) The first aspect is the recognition of the fact that some basic principles have been discovered empirically, based on the trials and errors of coaches, and more recently these principles have been scientifically established following research in which athletes, coaches and sports researchers were involved; (ii) The II aspect refers to the fact that these principles should be applied intelligently and adapted to the specific needs of people who practice certain sports, it being imperative to individualize sports training.

Recently, in the field of sports and especially in football, there is a tendency to change the approach to physical training and even to rethink the training methodology. This is due both to the professionalization of coaches and specialists and to the positive impact and extremely large influence that sports science has on the field.

Depending on the tactical concept, age and the position they occupy, young football players (12 – 18 years) can cover a distance of 6000m to 9000m during a football match. Of this total, between 350 and 550m are performed at high running intensities (16 – 19km□h-1), and 200m to 650m are covered by sprints over 19km□h-1. In the same study, the authors found that the level of running performance in the match is slightly influenced by age, the position that each player occupies, with central defenders covering the shortest running distance. The magnitude of the correlation between running performance during the match and physical capacity was found to vary considerably by position and level of physical capacity.

One of the most debated topics among football theorists and practitioners is the importance of developing a weekly plan structured in such a way that it touches the physical, technical, tactical and psychological aspects simultaneously and related to the demands of the game.

In football, physical training is certainly the component of training with the greatest advance both technically and conceptually in recent decades. This was made possible by extensive research and experience in the field of exercise physiology, supported by sports medicine.

By understanding the team's model of play (and the moments of the game), coaches must seek that ultimate balance between physical, technical and tactical workload. In planning modern training, it does not make sense to work in traditional blocks with different physical aspects (aerobic capacity - aerobic power - anaerobic

capacity - anaerobic power, etc.). In addition, according to Tactical Periodization, we divide the specific principles of the game into different levels of complexity:

• The main principles of the game: refer to the game relationships within the team;

• Sub-principles of the game: refer to the relations in the compartments (between the players in the same compartment) and the relationships between the compartments (defense - midfield - attack);

• Sub-sub-principles of the game: these refer to the individual, to the individual behavior during the game. Managing the complexity of the efforts made during the weekly cycle relative to the maximum intensity, aims to get the players as "fresh" as possible for the match.

Football periodization is a planned variation in training load and level of fatigue and should be designed in line with keeping the player's fitness at the highest possible level throughout the entire competitive season. Thus, the main objective of specialists working in elite football is to increase or at least maintain the level of performance throughout the competitive season and to decrease the frequency of injuries.

Analyzing the specialized literature, we can state that a tactical periodization model that integrates physical, technical, tactical and mental aspects in the same training session by well-established means is the most effective solution in planning training in elite football. The main objective is to keep the players in the best possible sporting shape without getting injured. Therefore, the aim is to find an optimized method of applying training tasks balanced with the competitive demands of the game, with the aim of achieving training adaptations and reducing the risk of injuries.

Recovery periodization also appears to play an important role in maintaining players' athletic fitness, and by monitoring and analyzing each training session and each match, the periodization model can be improved by optimizing training loads and alternating exercise loads in the weekly cycle.

In the preliminary research, our objectives are to highlight the progress in terms of physical training, through a systemic training model, based on tactical periodization, according to the technical-tactical concept of the club.

Thus, we applied a number of tests, initial and final test sessions, addressed to aerobic endurance, speed, strength and power. After that, the physical parameters were monitored during the official matches of the U19 team in the Elite League Group A championship, according to positions.

After performing the intermittent YO-YO test, I calculated the VO2max values and the maximum aerobic speed on the positions. Full-backs have the highest average value of VO2max, 58.85±1.39 ml/kg/min, and the lowest values were recorded by central defenders 49.73±4.33 ml/kg/min.

The correlation level between the VO2max values recorded during the field test and the mean values of the total distance traveled during the game is r 0.360, with positive statistical significance.

This shows that our second hypothesis is verified, namely that there is a statistically significant correlation between repeated sprinting ability and VO2max level in elite level U19 soccer players.

The statistical analysis of the data revealed a statistically significant correlation at $p<0.01$, between the maximum speed reached in the match and the values obtained in the strength tests SJ ML, SJ MB, CMJ MB, CMJ ML. Also following the statistical analysis, we observed a statistically significant correlation at r 0.05 between the distances traveled in speed zone 5 (> 25.20km/h) and SJ ML, CMJ ML. Correlations at r 0.01 we have between the number of accelerations with intensity between 3.00 and 50.00m/s2 and SJ ML, SJ MB, CMJ ML, CMJ MB, 15" BRJT, and standing long jump.

Also, the analysis of the results obtained following the SSG monitoring in the experimental group shows a significant increase in the total distance covered ($p<0.0005$), and the total distance traveled in the HSR ($p<0.0005$).

In terms of physical training, both methods are suitable for improving motor skills, however, the specifics of the game are included in SSG. Thus, in addition to the development of physical qualities, SSG increases engagement, therefore influencing the players' relationship with the demands of the game, favoring a learning environment by stimulating the ability to make decisions, according to the individual and collective behaviors inherent in the game, with possibilities. of increasing exploratory behavior, fundamental for the development of creativity, thus ensuring a transfer (adaptation, accommodation and understanding) of technical-tactical behaviors at the most contextual level possible, i.e. in the game

From an anthropometric point of view, the evaluations were carried out differently by positions, so both in the experimental group and in the control group the central defenders have the highest waist, and the shortest in the experimental group are the midfielders in the experimental group and strikers in the control group. In terms of body weight in the experimental group, central defenders have the highest values, forwards have the lowest. In the experimental group, the central defenders also have the highest values of body weight and the lowest values have the forwards. Regarding the percentage of adipose tissue, in the experimental group following the application of the training program, the central defenders recorded a decrease of 5.73, statistically significant ($p<0.0005$) in the values and at the group level they had the lowest values. The full-backs had the highest percentage of fat tissue in the final testing, but the entire team dropped below 10% in the final testing. In the control group, the highest values of the percentage of adipose tissue were in the forwards and the lowest in the full-backs. At the level of muscle mass, in the

experimental group the central defenders have the highest level of muscle mass within the group, the side defenders having the lowest values. In the control group, the full-backs have the highest muscle mass values and the forwards the lowest.

After the evaluation of the aerobic capacity, at the initial testing the subjects of the experimental group have a statistically significant ($p<0.005$) lower VO2max compared to those of the control group. On positions in the experimental group, the side defenders had the highest level and the central defenders had the lowest values. In the control group, the full-backs had the highest values and the midfielders the lowest. After applying the training program and performing the final tests, the situation changes and the subjects of the experimental group have statistically significantly ($p<0.025$) higher values compared to the values of the subjects of the control group. The increase in performance in the experimental group was statistically significant ($p<0.0005$), while the increase in the control group was statistically insignificant ($p>0.05$).

At the maximum aerobic speed, at the initial test, the values obtained by the subjects from the experimental group are statistically significantly lower ($p<0.005$) compared to the values from the control group. In terms of positions, in the experimental group, the highest values in the initial testing were for the full-backs and the smallest for the central defenders. In the control group, the full-backs had the highest values and the central midfielders had the lowest values.

At the final test the subjects of the experimental group obtain better average values compared to the control group, the difference is statistically significant ($p<0.025$), the increase in performance between the initial and the final test in the experimental group was statistically significant ($p<0.0005$) compared to of the control group where the increase in performance was statistically insignificant ($p>0.05$).

Although the experimental group started from significantly lower initial values compared to the control group at the level of aerobic exercise capacity, the application of the physical training program resulted in a significant improvement in the level of aerobic exercise capacity and in increasing VO_{2max}.

The correlation level between the VO_{2max} values recorded during the field test and the mean values of the total distance traveled during the game is r 0.360, with positive statistical significance.

Following the analysis, it can be seen that for the variable squat jump with hands locked on the hips, the forwards have the highest values, 39.11±4.68cm, followed by the central midfielders with an average of 38.43±4.74cm, and the full-backs with average values of 38.15±3.07cm. For the squat jump variable with free hands, the highest values were recorded by the full-backs with an average of 48.13±4.89cm, followed by forwards with average values of 46.30±3.18cm and central defenders with results average of 45.38±4.00cm. Regarding the counter

movement jump variable with hands locked on the hips, the hierarchy is the same as for the squat jump with hands locked on the hips, i.e. the forwards have the best values 42.69±2.85cm, followed by the side defenders with an average of 41.53±3.95cm, and in the case of the variable counter movement jump with free hands, the side defenders have the best results (49.85±4.00cm), followed by the forwards (47.85±3.95cm) and the central defenders (46.48±3.65cm), which indicates better intermuscular coordination and better elastic explosive strength in fullbacks, while forwards have better explosive strength.

As for the BRJT 15sec power test, the best values seem to be the central defenders (55.29±12.80w/kg), followed by the fullbacks (54.83±4.72w/kg) and forwards (50.42±9.38w/kg).

After analyzing and interpreting the data, it can be stated that the first working hypothesis is verified, namely that the application of our integrated physical training program will lead to a significant increase in the level of aerobic exercise capacity and muscle power in the lower limbs.

We also wanted to determine the effects that the application in training, of a program based on the game on a reduced field of 4vs.4 with goalkeepers, has on the external parameters of effort in junior soccer players U18. There is research that has verified that using 3vs.3 and 4vs.4 short-court games in training can, over time, bring benefits in terms of functional performance such as aerobic capacity, anaerobic capacity, vertical jump height (strength), strength; once the results obtained were similar to those obtained by traditional methods.

The players of the experimental group had a VO2max of 55.68±4.38ml/kg/min at the initial test, the values being homogeneous (CV=7.87%). After the application of the game program on a reduced field of 4vs.4 with goalkeepers, at the final test the average value of VO2max in the players of the experimental group had an increase of 10.34%, reaching 61.44±2.66ml/kg/min, a statistically significant increase ($p<0.0005$). at the same time the control group that followed a training program based on interval training on Wednesday and school game on Saturday, recorded an increase in VO2max of only 0.30% statistically insignificant ($p>0.05$). However, the subjects of the control group had a higher VO2max level at the initial tests 57.34±1.95ml/kg/min compared to those in the experimental group who started from 55.68±4.38ml/kg/min. In addition to maintaining aerobic capacity, to our knowledge, it appears that elite junior soccer players are more motivated during SSG than performing interval training. This may be because the effort and type of activity in the SSG is very close to that encountered during the match. This can motivate players to strive for and experience much greater sensations and feelings than interval training.

At 10m speed, the experimental group has a significant increase in performance ($p<0.0005$) of 6.70%. The control group has a significant increase in

performance as well ($p<0.0005$) but the rate of increase was lower than the experimental group of only 4.52%, but the difference between the two groups at the final test is insignificant ($p>0.05$) . The estimated importance of the cause on the effect being -0.8%. for the 20m sprint, the differences between the two groups at the final test are significant ($p<0.005$), the effect of the cause being 7.7%. Speed is the ability to perform a movement in a short period of time, and in the way football is played today, speed thus becomes a very important aspect in both attack and defense (Bangsbo, et., al, 2006) .

In agility without the ball, the differences between the two groups at the final tests are significant ($p<0.0005$), the effect of the cause being 47.6% ($ɯ2=0.476$). we can say that SSG's impact on agility without the ball is a significant one. In the SHDT ball agility test, the difference between the two groups is significant ($p<0.005$), the effect of the cause being 21.7%. Analyzing these data it can be stated that SSG have an increased effect on the ability to change the direction of travel and agility with and without the ball.

Also, the analysis of the results obtained following the SSG monitoring in the experimental group shows a significant increase in the total distance covered ($p<0.0005$), and the total distance traveled in the HSR ($p<0.0005$).

Analyzing the results, we noticed the existence of several correlations between the monitored parameters. Thus, we can see that there is a significant correlation between the total distance covered in the SSG and the VO2max level (.635), which makes us believe that the application of this training method is indicated both during the preparatory period and during the competitive season. Also the total distance covered in the SSG is strongly correlated with the results from the ball agility test. Something that can highlight the importance of specific means of training in the preparation of junior football players. Agility with the ball is also correlated with the VO2max level (.451), so the specific training based on technical-tactics also has benefits in the area of aerobic endurance.

Following the statistical analysis of the data, it can be said that during matches the central defenders have an average heart rate of 80±4.02% of FCmax, the effort zone thus being the one corresponding to aerobic power, spending in this effort zone an average of 48, 27±10.28min, of the total match time.

As with the effort parameters, center backs covered on average during the match 10033.79±1048.25m at an average speed of 5.88±0.50km/h in a pace of play of 92.51±9.46m / min. the total number of sprints per match being 28.74±10.76, the maximum speed recorded being 29.81±2.06km/h.

Distances in speed zone 5 with over 25.20km/h being on average per match 70.44±41.76m, and in speed zone 4 (19.80 – 25.19km/h) the average value was 422 ,33±130,10m.

The full-backs had during the match the average value of the heart rate of 78.22±2.90% of FCmax the effort zone being of aerobic capacity, the time being more, however, during the entire match being in the 3 effort zone 47:40±7:55 min, i.e. 80-89% of FCmax, corresponding to aerobic power effort.

Statistically analyzing the parameters of the external effort load, we observed an average of the total distance traveled by the full-backs per match of 10240.66±939.82m with an average speed of 6.01±0.52km/h, the average pace of play being 94.98±10.30m/min. The average number of sprints per match is 35.10±9.68, the average value of the maximum speeds recorded is 35.10±9.68km/h.

The values of the physiological parameters of the internal effort load of the lateral midfielders show an average of 98.16±7.59% of FCmax, while the average values of the average heart rate per match was 79.16±4.44% of FCmax, the medium effort zone being in aerobic capacity. But just like central defenders and wing backs, wing midfielders spent the longest period of total playing time in effort zone 3 (42:51±12:55min), corresponding to aerobic power effort (80-89% from FCmax). the total distance covered being 10265.57±1078.08m with a game pace of 96.20±12.06m/min and a total of 28.59±11.02 sprints per match.

The central midfielders have during the match the average FC volleys of 76.23±4.66% of FCmax, thus also in this case the average effort per match is within the area of aerobic capacity, but the longest time (43:58±20 :20min) was spent in the effort zone corresponding to aerobic power, i.e. 80-89% of FCmax. central midfielders ran an average of 10514.40±842.03m during the match at an average speed of 6.22±0.39km/h. the pace of the game was at 96.03±9.44 m/min with an average number of sprints per match of 24.77±8.61, the average value of the maximum speeds reached was 29.57±2.18km/ h.

The forwards have the average maximum effort intensity of 96.44±2.23% of FCmax, the average value recorded in the match was 77.81±4.36% of FCmax, with the longest duration spent in zone 3 of effort i.e. 41:03±10:53min. thus, also in the case of strikers, the average effort per match is located in aerobic capacity, but the longest duration is spent in aerobic power, i.e. in effort zone 3 80-89% of FCmax. the total distance covered by the attackers was 10012.63±876.85m with an average speed of 5.84±0.53km/h, the number of sprints being 39.75±11.23 with the average value of the maximum speed recorded during match of 30.71±1.52km/h.

After the statistical analysis of the data and the interpretation of the results, we can state that the second working hypothesis is verified, that is, the use of small-field games in the integrated physical training of U19 football players significantly influences the specific physical effort and implicitly leads to the improvement of the performance in the competition.