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Physical training of football players based on their positional rules in the team

Effects on performance-related factors

V. DI SALVO, F. PIGOZZI

Background. **The aim of this study was to evaluate the relative effectiveness of an individualized training programme for football players according to their positions in the team, by comparing it with a programme which did not differentiate roles, but utilized the same means for training.**

Methods. **Forty-four young top level football players divided equally into an experimental and a control group were submitted to two different training programmes for an 8-month period. Each group consisted of 5 forwards, 6 midfielders, 4 fullbacks, 4 centerbacks and 3 goalkeepers. The two groups had almost the same average age (17.8±0.6 and 17.7±0.6 yrs respectively), weight (72.6±4.7 and 72.8±3.7 kg) and height (181.3±4.4 and 180.3±4.0 cm). The following measurements were taken before and after the training period in order to evaluate the aerobic and anaerobic (lactacid and alactacid) power as well as explosive and elastic power which are related to football performance: running tests of 30, 50, 300 and 1,000 meters, squat jump (SJ), counter movement jump (CMJ) and repetition counter movement jump (test 15").**

Results. **A percent improvement observed for forwards and centerbacks was significant, in comparison with the control group, in all tests but the 30 and 1,000 meters run, on the contrary fullbacks and midfielders demonstrated a significant improvement only in the 1000 m run test ($p<0.01$). In addition, a significant increase (14%, $p<0.01$) was observed in CMJ of goalkeepers in the experimental group, in comparison with the control group.**

Conclusions. **It is concluded that individualized training developed in accordance with the real model of football performance and the different mechanisms of bioenergetic processes, is a superior method of training and can optimise the performance of all player in the team.**

KEY WORDS: Football - Exercise - Training, individual.

This work has already been presented at the 2nd Congress of the European College of Sport Science at Copenhagen, 20-23 August 1997.

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There is ample evidence to suggest that the position of the football players in the team is related to both their energy demands and their physiological characteristics. It has been shown in several studies that the distance covered during the game varies according to the positional roles. The greatest distance is covered by midfielders and the least by the centerbacks, while the frequency of jumps is greater among centerbacks and forwards than fullbacks and midfielders.[1-4] Moreover midfielders, fullbacks and forwards have a higher $\dot{V}O_2max$ than centerbacks and goalkeepers while centerbacks have a higher blood lactate concentration after maximal exhaustive exercise.[5] On the average football players stand still 17.1% of the total plain time, walk 40.4%, run at low speed (8-12 km·h^{-1}) 35.1% and at high speed (15-18 km·h^{-1}) 8.1% including 0.7% of sprinting at 30 km·h^{-1}.[5] It follows that all football players need to possess a high aerobic fitness in order to be able to sustain a high work-rate for 90 minutes, but according to their position in the team they may need a variant aerobic, anaerobic or explosive power.

The implicit postulate of these observations is that training programmes for football players should be tailored to the needs and demands of their positional role. However it is surprising that there is a scarce of information regarding both the importance of individualized training programmes according to the posi-

TABLE I.—*Characteristics of the training programmes designed to affect the different energy processes; and distribution of training time in percent allocated for the improvement of performance determinants of football players with respect to their positional role in the team.*

Energy process	Characteristics of training programme					Training time (%)			
	Total distance (km)	Repetition distance (m)	Repetitions (n)	Intensity (% max)	Pause (min)	A	B	C	D
Aerobic power	5-7	600-1200	6-10	80-85	2.30-4	10	5	15	0
Anaerobic lact. capacity	1-3	100-400	8-12	85-90	1-3	10	10	10	5
Anaerobic lact. power	0.5-1.5	50-300	5-10	90-95	2-5	10	10	15	10
Anaerobic alact. capacity	0.4-0.8	10-60	10-20	95-100	0.40-2	25	20	20	20
Anaerobic alact. power	0.2-0.6	5-40	8-12	98-100	2.30-4	20	25	15	25
Strenght						25	30	25	30

A=control group; B, C, D=experimental group (B=fowards-centerbacks, C=midfielders-fullbacks, D=goalkeepers).

tional roles in the team and their effects on performance-related factors. For this reason, the present study was undertaken in order to shed some high in this area.

Materials and methods

Subjects

Forty-four young top level football players equally divided into experimental and control groups were submitted to two different training programmes for an 8-month period, while participating at the National Championship in the year 1993/94 (control group) and in the year 1994/95 (experimental group). Each group consisted of 5 forwards, 6 midfielders, 4 fullbacks, 4 centerbacks and 3 goalkeepers. The two groups had almost the same average age (17.8±0.6 and 17.7±0.6 yrs respectively), weight (72.6±4.7 and 72.8±3.7 kg) and height (181.3±4.4 and 180.3±4.0 cm); neither were differences for these parameters between positional roles.

Training

All players were trained for a period of 8 months, 5 times a week followed by one day game and one day rest. The duration of each training session was approximately 3 hrs, equally devoted to skills, tactics and physical conditioning. The players of the experimental group were submitted to individualized training programmes designed in such a way as to a elicit appropriate adaptation to the different players according to their positional role in the game-play, while the conventional method of training was used for the control group, as shown in Table I. The following modes of training were utilised for the improvement of the muscular elastic and explosive strength: training machines, jumps, climbing race and towing race.

Measurements

The following measurements were taken before and after the training period in order to evaluate the aerobic and anaerobic (lactacid and alactacid) power as well as explosive and elastic power which are related to football performance:[6-8]

1) running tests of 30, 50, 300 and 1,000 meters in different days were carried out with a precision system of electronic photocells, using a free start in all runs in order to eliminate the influence of the reaction time;

2) jumping tests; the electronic apparatus "Ergojump" was used to evaluate the mechanical power of the leg extensor muscles during the explosive stretch shortening cycle of muscle contraction (7) in the form of squat jump (SJ), counter movement jump (CMJ), repetition counter movement jump (test 15"). Jumping tests were performed with hands placed on the hips.

Results

A systematic greater increase was observed in the players of almost all positional roles who were submitted to individualized training as compared to those who used the traditional team training approach. In general, a smaller improvement was expected in running tests and a marked one in jumping test. In order to resort to statistical analysis data obtained were pooled and treated in two homogeneous groups, *i.e.* those obtained from forwards and centerbacks on the one hand and those from fullbacks and midfielders,

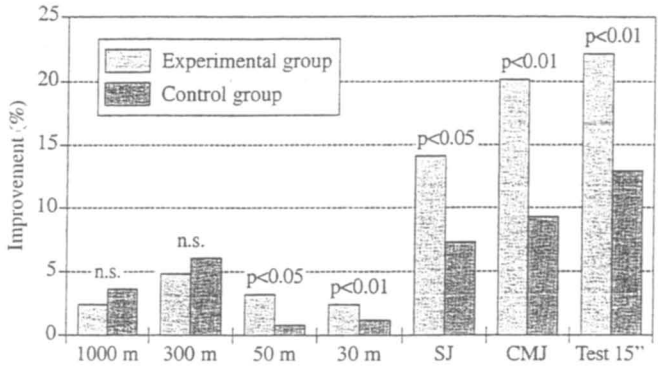

Fig. 1.—Percent improvement in performance-related factors for forwards and centerbacks for both the experimental (n=9) and control group (n=9) as a result of an 8-month training period. The abbreviations in the horizontal axis stand for running test of 1000, 300, 50 and 30 meters respectively, squat jump (SJ), counter movement jump (CMJ) and repetition counter movement jump (test 15").

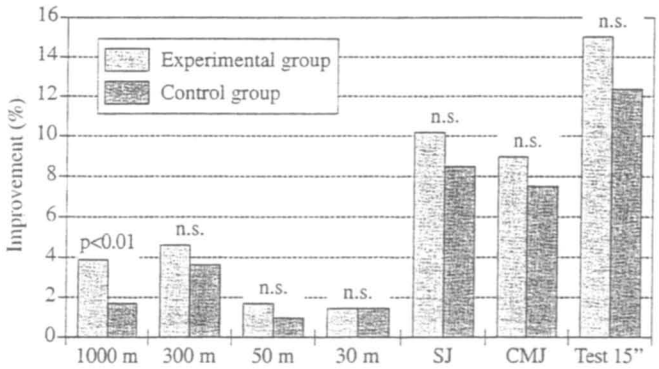

Fig. 2.—Percent improvement in performance-related factors for midfielders and fullbacks for both the experimental (n=10) and control group (n=10) as a result of an 8-month training period. For abbreviation of parameters see legend of Figure 1.

since the training between these two groups was distinctly different and that within each group very similar. Figure 1 shows the percent improvement for forwards and centerbacks and may be seen that it was significant, in comparison with the control group in all tests but the 300 and 1,000 meter-run. The most remarkable improvement has been noticed in the jump test, where the experimental group has shown an increase of 14, 20 and 22% in the SJ, CMJ and 15" test respectively.

On the contrary fullbacks and midfielders demonstrated a significant improvement (Fig. 2) only in the 1,000 m run test (3.92%, $p<0.01$). In addition, a significant increase (14%, $p<0.01$) was observed in CMJ of

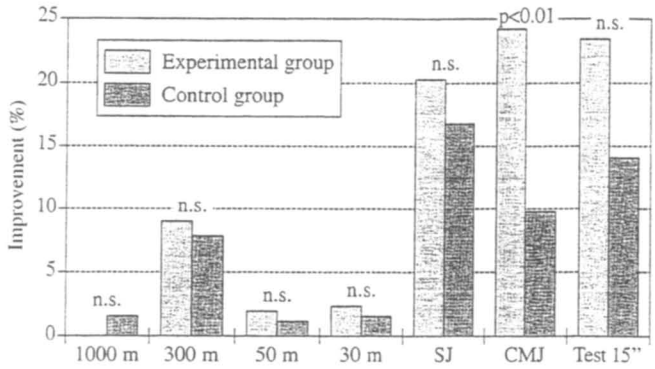

Fig. 3.—Percent improvement in performance-related factors for goalkeepers for both the experimental (n=3) and control group (n=3) as a result of an 8-month training period. For abbreviation of parameters see legend of Figure 1.

goalkeepers of the experimental group, as compared to the control group (Fig. 3).

Discussion and conclusions

The aim of this study was to assess an individualized training programme for football players according to their positions on the team, by comparing it with a training programme (control group) which did not differentiate roles, but utilized the same means for training. The close collaboration between the trainer and the coach during the training session, allowed the former to carry out the required individualized technical-tactical work.

The analysis of anthropometrical measurements has shown the goalkeepers and centerbacks were taller and older than the other football players, characteristics which are similar to those noticed in Danish professional football players [8] and in other studies carried out by Bell,[9] Rhodes [10] and Reilly.[11]

The training programme of the experimental group was constructed taking into consideration the bioenergetic differences mentioned in the literature for football players and their positions in the team.[1-5] In particular, since the aerobic power of midfielders and fullbacks is higher than that observed in players of other positions,[8-12] more emphasis was given in the improvement of this parameter and hence a more marked increase was observed in midfielders and fullbacks as result of this type of individualized training. The best performance with respect to the alactacid anaerobic power (300 m test), was noted in the full-

backs of both groups. Thus, training in this energetic mechanism was further stimulated in the fullbacks of the experimental group, who showed more improvement in comparison with both the other positions and the control group at the end of the 8-month training period. The model of the football players performance shows the need for centerbacks and forwards to increase as much as possible their alacticid anaerobic power.[1-3] Thus, the greater percentage of work carried out in players of the experimental group belonging to these two positions, was to develop their strength and alacticid anaerobic capacity and power. The goalkeepers of the experimental group carried out a training programme in order to improve strength and alacticid anaerobic power.[1] No training for the goalkeepers of the experimental group was carried out to improve aerobic power.[8] The considerable increase in the explosive and elastic power observed in those groups which carried out a more intensive and specific strengthening work (goalkeeper, centerbacks and forwards), confirmed early studies of De Proft *et al.*[13] who noticed increases in the eccentric strength of the knee flexor muscles of 77% and of 25% in the concentric strength of the knee extensor muscles in a group of Belgian football players who were subjected to a strenuous strength training for eleven month (two sessions per week of 30 minutes duration each). Aagaard *et al.*[14] in a study on the isokinetic strength of the knee extensor muscles carried out in professional Danish football players, showed that goalkeepers and forwards had statistically significant higher maximal strength than the other players in the team, for this reason and on the basis of previous studies [16-18] heavy loads were utilized in the training procedures for the goalkeepers of the experimental group.

It follows from the preceding discussion that, the adoption of an individualized training developed in accordance with the real model of football performance and the different mechanisms of bioenergetic processes, is a superior method of training and can optimise the performance of all player in the team.

Although, in some cases the improvement of performance with individualized training was slight, it appears that even this slight improvement can be of significant value in competition. An additional value of the individualized training may be the positive psychological effect which has on the players who seem to be more motivated during the workouts, since the programme is tailored to their capacities and needs. Finally, it should be pointed out that the experimental group in the present study consisted of players 18 years of age who made the team which won the Italian Football Championship in that year. In our view an individualized training for football players should not begin before full maturity, because training during growth should aim at development of all energy mechanisms required in playing football.

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