



S. N. Malakhova

**Comparative analysis of central hemodynamics and physical performance in football players of various sports qualifications**

Zaporizhzhia State Medical University

**Key words:** football players, heart rate variability, central hemodynamics, physical performance.

**Aim.** To determine the influence of sports qualification of football players on parameters of heart rate variability, central hemodynamics and physical performance.

**Methods and results.** At the beginning of the preparatory period examination of 73 football players of various sports qualifications was carried out. It was established that relative value of physical performance and index of the functional state (IFS) are at a high enough level for all football players. That once again confirms the orientation of the training process on the development of power-speed qualities with the appearance of a high-level general, speed and special endurance.

**Conclusion.** Economization of physiological functions of qualified football players manifested by bradycardia, prevalence of hypokinetic type of circulation (TC) and is lack in group of qualification of MS and CMS athletes with hyperkinetic TC.

**Порівняльний аналіз показників центральної гемодинаміки та фізичної працездатності у футболістів різної спортивної кваліфікації**

С. М. Малахова

З метою визначення впливу спортивної кваліфікації футболістів на параметри варіабельності серцевого ритму, центральної гемодинаміки та фізичної працездатності здійснили дослідження за участю 73 футболістів кваліфікації від II–III розрядів до майстра спорту України. Порівняли дані вегетативного забезпечення спортивної діяльності, центральної гемодинаміки, фізичної працездатності та індексу функціонального стану у футболістів залежно від спортивної кваліфікації. З'ясували, що оскільки за більшістю показників, які вивчили, між футболістами кваліфікації КМС і I розряд відсутні вірогідні відмінності, для коректності інтерпретації даних доцільно надалі формувати об'єднану групу, зокрема КМС–I розряд.

**Ключові слова:** футболісти, варіабельність серцевого ритму, центральна гемодинаміка, фізична працездатність.

*Запорізький медичний журнал.* – 2015. – №1 (88). – С. 28–30

**Сравнительный анализ показателей центральной гемодинамики и физической работоспособности у футболистов различной спортивной квалификации**

С. Н. Малахова

С целью определения влияния спортивной квалификации на параметры вариабельности сердечного ритма, центральной гемодинамики и физической работоспособности провели исследование, в котором приняли участие 73 футболиста квалификации от II–III разрядов до мастера спорта Украины. Сравнили данные вегетативного обеспечения спортивной деятельности, центральной гемодинамики, физической работоспособности и индекса функционального состояния у футболистов в зависимости от спортивной квалификации. Установили, что поскольку по большинству изучаемых показателей между футболистами квалификации КМС и I разряд отсутствовали достоверные различия, для корректности интерпретации данных целесообразно в дальнейшем формировать объединенную группу, а именно КМС–I разряд.

**Ключевые слова:** футболисты, вариабельность сердечного ритма, центральная гемодинамика, физическая работоспособность.

*Запорожский медицинский журнал.* – 2015. – №1 (88). – С. 28–30

Analysis of sports and medical literature shows, that insufficient attention is paid to the questions of functional fitness of the sportsmen, playing team sports. Some authors consider [7] that the complexity of qualified recommendations is that in team sports is optimal coherence of the various body systems. Quantitative characteristic of which is possible only if a comprehensive diagnosis of the functional state of organs and systems: cardiovascular, respiratory, neurohumoral, visual analyzer and others was done.

Specific features of the organization of the study and training process in football are very complex research object, so one should be careful in formation of the conclusions and recommendations [3,4].

Some authors consider that the high complexity of the competitive activities of a football player makes high demands on all parties of the sportsman fitness, because acting in the conditions of the hard combat, while being in non-standard

situations with lack of time and space, football player must securely and efficiently solve technical and tactical tasks [1,2,6].

**The aim** of this study was to determine the influence of sports qualification of football players on the heart rate variability parameters, central hemodynamics and physical performance.

**Materials and methods**

At the beginning of the preparatory period, a comprehensive examination, including the definition of anthropometric parameters, heart rate variability, central hemodynamics, physical performance and index of functional state in 73 football players was carried out. The data was divided by sport qualification into four groups for convenience of interpretation.

The first group included 14 athletes who have qualification of Master of Sports of Ukraine (MS), mean age was 27,00±1,36 years, the experience of playing football – 17,00±2,0 years. The second group consisted of players with qualification of Candidate of Master of Sports (CMS) – 9 people, average age



was  $20,00 \pm 0,93$  years, the experience of playing football –  $10,00 \pm 1,33$  years. Third – sportsmen of I qualification level – 34 people, average age  $17 \pm 0,19$  years, experience of employment –  $8,00 \pm 0,51$  years. Fourth – athletes of II-III qualifications level – 16 people, average age  $16 \pm 0,43$  years, the experience of playing football  $7,00 \pm 0,74$  years.

For the analysis of vegetative regulation of cardiac activity time and frequency components of heart rate, type of circulation (TC) were used. Central hemodynamics were studied by automated tetrapolar rheography by W. Kubiček et al. (1970) in the modification Y.T. Pushkar et al. (1970). Determination of physical performance was carried out by the standard technique with submaximal cycle ergometer test  $PWC_{170}$ . The index of the functional state (IFS) was calculated according to the formula proposed and patented by us [5].

Statistical analysis was performed using a statistical software package «Statistica 6.0» and Microsoft Excel. The arithmetic mean (M), the mean error (m) were performed. The data obtained are presented in the form of  $M \pm m$ . In the case of distribution close to normal, evaluations of the statistical significance was performed by Student t-test. Difference was considered statistically significant at a probability of  $p < 0,05$ .

### Results and discussion

Surveyed football players differed by age and seniority playing football with varying degrees of reliability, unlike athletes of CMS–I level qualification and of I–II-III level qualification in which there were no significant differences.

Anthropometric magnitude was characterized by the absence of significant differences in the body height in football players MS and CMS qualification, of MS and with I level qualification, as well as in CMS and ones with I level qualification.

Body weight was significantly lower as the age and qualifications level of the football players from the MS to the II-III level, with an exception of athletes, who have CMS and I level qualifications, in whom there were no significant differences.

Comparison of the data of heart rate variability in football players, different in qualifications, indicates the relative homogeneity of the average values of time and frequency parameters. The exception was the index of LF, serving as an indicator of predominantly sympathetic tone, which was significantly bigger, than in players – MS, CMS and with I qualification level, compared with players with II-III level, respectively,  $p < 0,01$ ,  $p < 0,05$ ,  $p < 0,05$ .

Heart rate in football players with MS qualifications was significantly lower than in football players with I level ( $51,0 \pm 1,9$  vs.  $58,0 \pm 1,3$  beats/min,  $p < 0,01$ ) and even more so than in athletes with II-III level in which the heart rate averaged  $71,0 \pm 3,6$  beats/min ( $p < 0,001$ ).

Comparison of the central hemodynamic parameters in the surveyed football players showed a continuing trend to lack of significant differences between athletes – CMS and with I qualification level. The average value of CI at football players – MS, CMS and with I qualification level did not differ in themselves and was within the values corresponding to the

hypokinetic TC. Statistically significant differences were found in the athletes of these qualifications in relation to the players qualifications of the II-III level, which corresponds to the average value of the CI eukinetic TC. This is confirmed in the analysis of types of circulation. So, the football players qualifications of MS ratio among TC have: 78,6%:21,4%:0%, respectively hypo-, eu- and hyperkinetic TC. This ratio was 77,8%:22,2%:0% in football players with CMS qualifications, and respectively, 61,8%:35,3%:2,9% and 25,0%:62,5%:12,5% in players with I and II-III qualification levels. Thus, if hypokinetic TC dominates in the football players - MS, CMS and with I qualification level and in first two groups was no athlete with hyperkinetic TC. Then number of football players with hypokinetic TC decreases with qualification level from I to II-III. In the future, this leads to the predominance of the eukinetic TC in athletes with II-III level.

The average value of  $PWC_{170}/kg$  in football players did not differ between MS and CMS qualifications, CMS and I level and was, respectively  $20,45 \pm 0,65$  vs.  $19,17 \pm 0,69$  and  $19,17 \pm 0,69$  vs.  $18,18 \pm 0,54$  kgm/min/kg ( $p > 0,05$ ). Significant differences  $PWC_{170}/kg$  at the level  $p < 0,01$  were observed in the football players - MS and with I level, MS and II-III level, CMS and II-III level, I level and II-III level of qualification.

The average value of the ISF had significant differences between football players of MS and CMS qualifications ( $8,087 \pm 0,34$  vs.  $6,962 \pm 0,37$  relative to unit ( $p < 0,01$ )). The regular differences of ISF were fixed between football players - CMS and with I qualification level ( $p < 0,01$ ), and MC and II-III level ( $p < 0,001$ ), and CMS and II-III level ( $p < 0,05$ ). Besides there were no significant differences of ISF in football players qualifications of CMS and I level, as well as between athletes of I and II-III level of qualification. According to our proposed gradation in football players with MS qualifications IFS assessment showed average result, and in athletes - CMS, I and with II-III qualification level – below average.

### Conclusions

1. The majority of the surveyed football players with different in sport qualifications had significant differences in age, years of playing football, height and weight of the body except the athletes - CMS and with I qualification level.

2. Surveyed football players with different qualifications had no significant differences in the average time and frequency of heart rate variability parameters.

3. The economization of physiological functions of the qualified football players was manifested in bradycardia, prevalence of hypokinetic TC and lack in group with MS and CMS qualifications athletes with hyperkinetic TC.

4. The relative value of physical performance and IFS were increased in all football players, that again proves the orientation of the training process on the development of power-speed qualities with the appearance of a high-level general, speed and special endurance.

5. Absence of the statistically significant differences in the majority of the studied parameters between football players - CMS and with I qualification level gives base in the future for the correct interpretation of data, to form a united group, namely I level-CMS.

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**Information about author:**

Malakhova S.N., MD, PhD, Assistant Professor of the Department of Physical Rehabilitation, Sports Medicine, Physical Training and Health, Zaporizhzhia State Medical University, E-mail: malakhova\_sn@ukr.net.

**Відомості про автора:**

Малахова С.М., к. мед. н., асистент каф. фізичної реабілітації, спортивної медицини, фізичного виховання і здоров'я, Запорізький державний медичний університет, E-mail: malakhova\_sn@ukr.net.

**Сведения об авторе:**

Малахова С.Н., к. мед. н., ассистент каф. физической реабилитации, спортивной медицины, физического воспитания и здоровья, Запорожский государственный медицинский университет, E-mail: malakhova\_sn@ukr.net.

Поступила в редакцию 17.02.2015 г.