

Physiology

Study of Physical Performance of Highly Skilled Football Players via Physical Working Capacity Test

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ABSTRACT: In the present work the changes in physical performance of highly skilled adult football players, wrestlers and adolescent football players as a result of 1.5-month workout are studied using physical working capacity test (PWC_{170}). Although at the end of the workout period the level of physical endurance reliably increased in all three groups of athletes, clear difference between the parameters of physical working capacity of adult players/adult wrestlers and adolescent football players was not observed. Physiologically, muscular work in football considerably increases physical working capacity and, accordingly, physical performance – endurance. Therefore, after workout the parameters reflecting physical working capacity of adult football players should have been greater. However, it turned out that athletes of all three groups had almost identical values of those parameters. We would assume that the workout of adult football players should be focused on physical loading for endurance that does not often occur despite the requirements of modern football. © 2014 Bull. Georg. Natl. Acad. Sci.

Key words: PWC_{170} test, heart rate

Study of issues of physical training of football players on endurance implemented via determination of physical working capacity (PWC) during medical examination is considered to be one of the most important problems of football [1].

PWC reflecting value is directly proportional to the quantity of mechanical work, which can be implemented by a human (athlete) during muscular action (work) carried out with high intensity [2]. The most precise PWC study among athletes occurs via determination of oxygen quantity consumed under conditions of muscular load, during which the value of maximum oxygen consumption ($V_{O_2 \max}$) is defined,

which clearly shows PWC ability of the organism and, therefore, physical feature – endurance.

In sports medicine a PWC study is carried out according to number of heart contractions (NHC). There is a direct relation between NHC and muscular action power. The dependence is preserved until NHC is equal to 170 (130-170) per minute during muscular work [3]. At this time cardiovascular system is in the optimal zone of functioning, while when NHC is 170-180 per minute during muscular work, the direct relation between muscular work capacity and NHC is violated. From a certain moment heart starts to work uneconomically which is, first of all, manifested in

Table. Changes ($p < 0.0001$) obtained in regard to PWC_{170} kgm/min/kg and $V_{O_2 \max}$ ml/min/kg data for all three groups of athletes after completion of workout period

M(n) Groups of athletes	PWC_{170} kgm/min/kg		$V_{O_2 \max}$ ml/min/kg	
	before workout	after workout	before workout	after workout
I group	18.09 (2.93)	20.36 (3.06)	51.48 (7.15)	56.27 (7.52)
II group	18.40 (2.46)	19.47 (2.40)	56.0 (17.88)	58.63 (17.16)
III group	18.60 (2.85)	21.10 (12.61)	51.50 (9.12)	82.70 (117.93)

reduction of systolic volume [4]. NHC is also in the same direct relation with maximal oxygen consumption [5].

The mentioned parameters are basically determined via studies conducted by indirect process, since their research using direct process faces athletes a variety of inconveniences (intensive muscular work up to maximum limit, breathing by the use of special bags under conditions of physical load etc.) that is really unacceptable for the most part of the examined persons [6].

It is known that during workout (training) the values of PWC indices of working out athletes (cyclers, oarsmen, football players) in relation to endurance are higher compared with athletes being trained in speed-strength sports directions (boxers, wrestlers) [7]. Dynamic observation of the athletes PWC is one of the most effective methods of training adjustment [8].

Research Aim. Research aim was to study PWC_{170} via carrying out test on physical condition – endurance of highly skilled football players.

Objectives. 30 highly skilled football players of premier league at the age of 21-30 (adult) have been studied. With the purpose of comparative assessment of values of parameters reflecting PWC of athletes a study of 20 highly skilled adult wrestlers and 33 adolescent (15-18 years old) football players have been conducted for the same period of training (dur-

ing 1.5 months). In total 83 athletes were studied. They were divided into 3 groups: group I was represented by adult football players, group II belonged to adult wrestlers, while group III was composed of adolescent football players.

Research Methods

Determination of athletes' PWC_{170} by step-test was conducted in the laboratories of functional diagnostics of Sports Medicine Centers (Clinical Center of Sports Medicine and Rehabilitation, Tbilisi State Medical University and Tbilisi City Sports Clinic Center) with the use of veloergometers (stationary bicycles) of "Monarch"-type. During the loading a heart rhythm of athletes was registered by electrocardiogram. In order to get rid of text overloading only two significant parameters are considered in the work – value of physical working capacity PWC_{170} 1 kilogram-meter per 1 minute and per 1 kilogram of weight (PWC_{170} kgm/min/kg) and maximal oxygen consumption - 1 milliliter per 1 kilogram of weight and per 1 minute (ml/min/kg), which were calculated with the use of special formula and Table [4,5].

Statistical Data Processing

Statistical analysis of material was out using computer program SPSS.20. Nonparametric statistical method – Wilkinson criteria and parametric T-test have been used. For all three groups of athletes, the

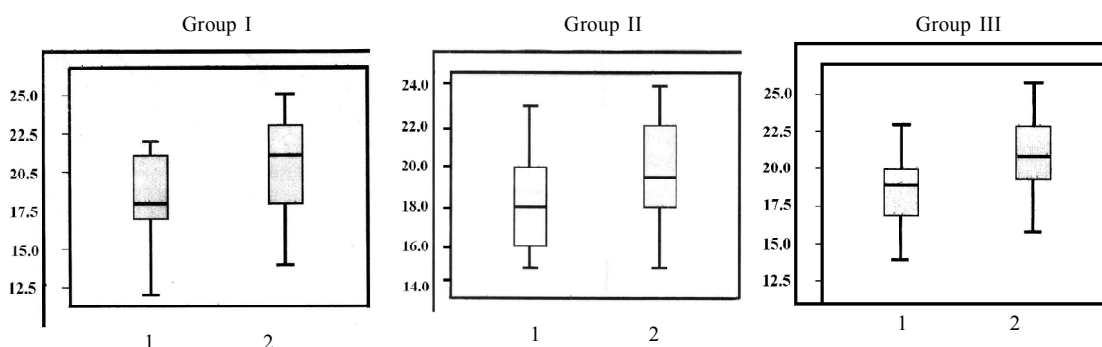


Fig. 1. Graphic representation of PWC_{170} kgm/min/kg; data of 1st and 2nd researches in highly skilled athletes of all three groups at the end of workout period (1.5 months)

changes received during training period (1.5 months) in regard to mentioned parameters turned out to be statistically significant ($p < 0.0001$).

Research Results and Discussion

At the initial stage of training period in all three groups of athletes almost identical values of PWC_{170} kgm/min/kg were observed. Some difference was observed among the values of ml/min/kg. As a result of workout carried out during 1.5 months in all three groups of athletes the above-mentioned parameters experienced changes of positive nature, i.e. they increased (Table 1).

On the basis of statistical data processing as a result of workout in all three groups of athletes a graphic representation of dynamics of the mentioned parameters gave us the same picture of positive nature (Figs. 1 and 2).

The given graphic representation points at the fact that at the end of workout period, changes of both parameters taken place in all three groups of athletes point at the improvement of their physical condition, namely their endurance.

Despite the fact that after training in athletes being under observation have been positive changes in regard to PWC were obtained. It turned out nevertheless that for I and II groups of athletes (football players and wrestlers) we were unable to obtain clear difference between values of parameters reflecting PWC as it should be physiologically. Based on this circumstance, during training process of football play-

ers special attention should be focused on muscular work – endurance, in contradistinction from workout conducted for wrestlers, where emphasis is made on physical load basically oriented at speed and strength. The above-mentioned points at the fact that during training of the football players insufficient attention was drawn to physical loads – endurance. PWC_{170} per 1 kilogram of weight of adult football players was less than 21 in average (Table 1), while this index among trained premier league adult football players should be at least 21-22 in average [3,7].

Inappropriate changes were received in regard to PWC parameters in adult and adolescent football players. After training, PWC parameters of adolescent football players were higher compared with adult football players while it should be vice versa according to physiology (Table, Fig. 1 and 2). The same result was received in regard to parameter.

It is established that in athletes (football players) trained in one and the same sports the level of physical conditioning in regard to endurance in adult was basically higher in comparison with trained adolescent athletes (football players) [1,3]. It is noteworthy that the examined highly skilled adolescent athletes according to their sports achievements (according to results of international matches) were characterized by better data in contradistinction from adult football players. The same high sport results were observed among the wrestlers. Proceeding from the above-mentioned we should assume that one of the reasons of comparatively inappropriate level of play

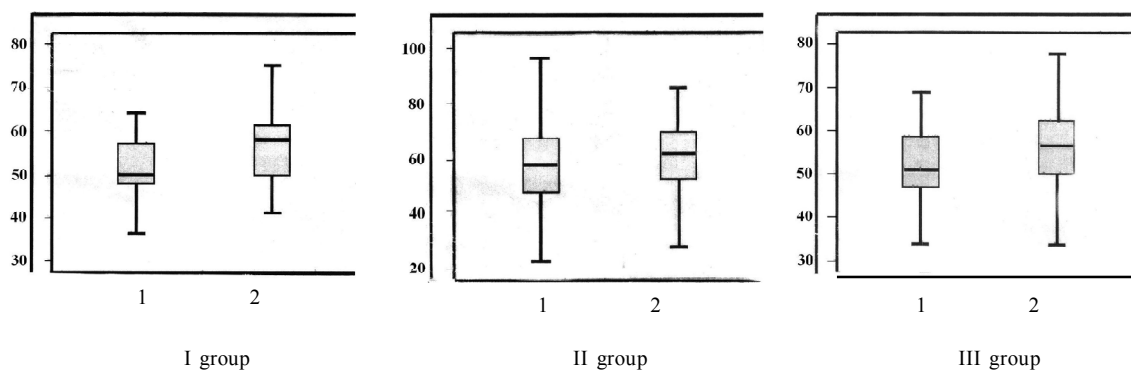


Fig. 2. Graphic representation of $V_{O_2 \max}$ ml/min/kg data of 1st and 2nd researches in highly skilled athletes of all three groups at the end of workout period (1.5 months).

in matches shown by highly skilled adult football players being under our supervision was caused by the inconsistent general physical condition, in particular by physical feature – endurance.

Conclusions

Determination of physical working capacity, i.e. endurance must be conducted in dynamics, from time to time, using testing method, especially for assessment

of physical feature – endurance level of highly skilled football players in relation to their workout in modern football and their appearances (playing the matches).

Special attention in preparation of adult highly skilled football players of premier league of Georgia should be drawn to considerable improvement of their physical feature – endurance, since modern football requires it.

ფიზიოლოგია

ფიზიკური შრომისუნარიანობის განსაზღვრით მაღალი კვალიფიკაციის ფეხბურთელების ფიზიკური თვისების - გამძლეობის შესწავლა

რ. სვანიშვილი

თბილისის სახელმწიფო სამედიცინო უნივერსიტეტი

(წარმოდგენილია აკადემიკოს მ. ხახანაშვილის მიერ)

წარმოდგენილ ნაშრომში ფიზიკური შრომისუნარიანობის განსაზღვრული ტესტით (PWC₁₇₀) შესწავლილია წვრთნის შედეგად მაღალკვალიფიციური უფროსი ასაკის ფეხბურთელების, მოჭიდავეებისა და მოზარდ ფეხბურთელთა ფიზიკური თვისების - გამძლეობის მხრივ 1.5 თვის განმავლობაში განვითარებული ცვლილება. სამივე ჯგუფის სპორტსმენებში საწვრთნელი პერიოდის ბოლოს, მართალია, სარწმუნოდ მოიმატა ფიზიკური გამძლეობის დონემ, მაგრამ არ აღინიშნებოდა მკვეთრი სხვაობა უფროსი ასაკის ფეხბურთელების ფიზიკური შრომისუნარიანობის პარამეტრების სიდიდეებსა და უფროსი ასაკის მოჭიდავეებისა და მოზარდი ფეხბურთელების იმავე მონაცემებს შორის. ვინაიდან ფიზიოლოგიურად ფეხბურთში წარმოებული კუნთური მუშაობა მნიშვნელოვნად ზრდის ფიზიკურ შრომისუნარიანობას და, შესაბამისად, ფიზიკურ თვისებას - გამძლეობას, ამიტომ გაგარჯობების შემდეგ უფროსი ასაკის ფეხბურთელებს ფიზიკური შრომისუნარიანობის ამსახველი პარამეტრები ბევრად უფრო მეტ სიდიდეებში უნდა ჰქონოდათ წარმოდგენილი. პირიქით, სამივე ჯგუფის სპორტსმენებს აღმოაჩნდათ ამ პარამეტრების თითქმის ერთნაირი სიდიდეები. უნდა მივიჩნიოთ, რომ უფროსი ასაკის ფეხბურთელთა წვრთნაში განსაკუთრებული ყურადღება უნდა ეთმობოდეს ფიზიკურ დატვირთვებს გამძლეობაზე, რაც ხშირად არ ხდება, მაშინ როდესაც ამას მოითხოვს თანამედროვე ფეხბურთის განვითარება.

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