Effect of Team Sports on Aerobic Performance of Human Body in View of Somatotype

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Abstract

Background/Objectives: Methodology of athletes' health improvement should be based on integrated consideration of the body features. Search for dependence and functional capabilities of the body on anthropometric typology can be a criterion for the development of individual methods of adaptation in the course of muscular activity. Methods: The experiment was carried out on a longitudinal basis for 3 years. The examination cohort included young athletes of Children's and Youth Sports School of Olympic Reserve. In total, 80 persons aged from 10 to 20 were examined. Results: Somatotypological approach was suggested for solving the problem of individualization of training loads. The authors showed that in the course of basketball and football trainings the representatives of brachymorphic somatotype formed the primary risk group: they demonstrated the lowest VO2Max values, while the highest values were found among the representatives of different somatotypes in aerobic performance of the body, which determines individual typological differences in general stamina and adaptive capabilities of athletes' bodies. Consideration of typological features of athletes' constitution and assessment of aerobic performance of the body form a unified set of information, on the basis of which adequate and personalized recommendations can be developed resulting in optimization of motional modes for a particular group of exercisers. Application: Recognition of typological peculiarities of athletes allows setting regulatory requirements in accordance with adaptive capabilities of athletes. This article is of value for teachers and trainers of Youth Sports Schools of Olympic Reserve and sports departments, sports medicine doctors and students.

Keywords: Basketball, Football, General Stamina, Maximum Oxygen Consumption (VO2Max), Somatotype, Students, Young Basketball Players, Young Football Players

1. Introduction

Team sports are the most widespread and popular sports among the young people. Such team sports as football and basketball impose great requirements for current functional state of the body. Proper implementation of sports capabilities and high competitive results are limited to a large extent by morphofunctional peculiarities of the body. Sports physiologists are interested in identification of typological characteristics of athletes to determine a somatotype with a high level of aerobic performance, which is important while going in for team sports. Research of the interrelation between anthropometric typology and values of aerobic performance of the body which determine its general stamina may be a criterion for optimal efficiency of the training process1.

Maximum oxygen consumption (VO2Max) is a good indicator of energy supply for physical load and one of the most efficient factors of development of the general physical stamina. This indicator serves as an integral characteristic of the condition of respiratory and circulatory systems, blood supply capacity of working muscles and critical level of aerobic metabolism2. Trained athletes with a wider range of functional and reserve body capabilities demonstrate a significant increase in VO2Max2,3. High capacity of aerobic performance allows athletes (particularly, in case of football) to develop significant ability of movement and show high sports results due to increase in the duration of work under conditions of aerobic metabolic energy supply.
Our task was to determine the nature of interrelations of constitutional type and to implement an individualized approach in physical education of schoolchildren and students.

Purpose of the research was to study aerobic performance of the body (VO₂Max) of basketball and football players aged 10-20 in view of their constitutional type, to determine their individual peculiarities – constitutional type, energy profile, general stamina level.

2. Methods

The experiment was carried out on a longitudinal basis for 3 years with the same examined athletes, who engage in sports activities on a regular basis in sports departments of Children’s and Youth Sports School of the Olympic Reserve and further in the Institute of Physical Culture and Judo of Adyghe State University, Maykop, Russia. In total, 80 basketball and football players aged from 10 to 20 were examined. Not only sports background, but physical history was thoroughly examined. In order to standardize the conditions, all examinations were carried out in the morning hours (9-12 a.m.) at a comfort temperature (18–20°C) at the premises of the Child Development Physiology Laboratory of the Research Institute for Complex Problems at Adyghe State University. Examination was held twice a year – in autumn (October-November) and in spring (March-April), since these periods are characterized with optimum level of adaptation to physical loads, or, on the contrary, development of fatigue in case of unreasonably structured training sessions.

When assessing age, we relied upon the guidelines of international classification⁴, and the examined persons were divided into three age-related development periods: second childhood (10-12 years), adolescence (13-15 years) and preadult age (16-20 years).

Assessment of aerobic performance of the body included determination of maximum oxygen consumption (VO₂Max). Calculation of VO₂Max in relative units per kilogram of body weight was carried out in the automatic mode using “Poly-Specter” software by the formula of V. L. Karpman⁵.

On the basis of the integral analysis of somatic values, basketball and football players were divided into three somatotypes within each age group: Brachymorphic (B), Mesomorphic (M), Dolichomorphic (D) – in accordance with the international Anthropometric Standardization Manual (ASRM) and the scheme of B. H. Heath and Z. Carter¹. The obtained values of aerobic performance (VO₂Max, ml/min/kg) were analyzed subject to somatotype of the examined athletes.

Statistical processing of results was carried out by means of STATISTICA 6.0 software package.

3. Results

According to the data provided by many authors²-⁶, constitutional type and energy supply peculiarities are closely interrelated. Constitutional type may be used as a marker of energy supply type, and, consequently, it will allow selecting athletes on the basis of external features.

Analysis of values of aerobic performance (VO₂Max) in young athletes of different somatotypes has shown Table 1 football players aged 10-12 having M-type bodybuild demonstrated the highest values of aerobic performance. The representatives of D-type bodybuild had reliably (p<0.05) lower values of the general stamina as compared with M-type bodybuild.

<table>
<thead>
<tr>
<th>Age</th>
<th>Constitutional type</th>
<th>VO₂Max (ml/min/kg)</th>
<th>VO₂Max (ml/min/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Second childhood</td>
<td>M-type</td>
<td>56.8±0.1</td>
<td>51.4±0.3</td>
</tr>
<tr>
<td></td>
<td>D-type</td>
<td>50.1±0.3</td>
<td>49.1±0.1</td>
</tr>
<tr>
<td></td>
<td>B-type</td>
<td>33.2±0.2</td>
<td>34.0±0.2</td>
</tr>
<tr>
<td>Adolescence</td>
<td>M-type</td>
<td>57.3±0.4</td>
<td>54.2±0.1</td>
</tr>
<tr>
<td></td>
<td>D-type</td>
<td>55.8±0.5</td>
<td>50.3±0.3</td>
</tr>
<tr>
<td></td>
<td>B-type</td>
<td>38.0±0.1</td>
<td>42.2±0.3</td>
</tr>
<tr>
<td>Preadult age</td>
<td>M-type</td>
<td>59.2±1.1</td>
<td>48.4±1.9</td>
</tr>
<tr>
<td></td>
<td>D-type</td>
<td>54.4±1.4</td>
<td>53.1±2.3</td>
</tr>
<tr>
<td></td>
<td>B-type</td>
<td>46.5±1.5</td>
<td>43.1±2.4</td>
</tr>
</tbody>
</table>
to M-type, while the lowest values of such indicators were shown by the representatives of B-type bodybuild.

In the age period of 13-15 years, young football players having M-type bodybuild revealed the highest values of aerobic performance. Though, the difference in the values of aerobic performance between the M-type and D-type representatives was unreliable (p>0.05). At the same time, in such age period the representatives of B-type had significantly lower values of aerobic performance as compared to M-type and D-type.

Students (aged 16-20 years) engaged in football also demonstrated a trend toward maintaining high values of VO\textsubscript{2} Max in the representatives of M-type as compared to the D-type football players. The student football players of B-type were characterized with reliably lower values of VO\textsubscript{2} Max as compared to the representatives of the other two types.

Comparison of aerobic performance of football players between the representatives of the same somatotype in different age periods revealed consistent increase in VO\textsubscript{2} Max, the M-type representatives aged 13-15 had no reliable increase in VO\textsubscript{2} Max values. While in the same age period the representatives of D-type and B-type showed significant increase in VO\textsubscript{2} Max value (+5.7 ml/min/kg and +4.8 ml/min/kg, respectively). Increase in VO\textsubscript{2} Max value for the M-type and D-type representatives of the preadult age was insignificant, while VO\textsubscript{2} Max value of the B-type representatives reliably decreased as compared to the adolescent age. Consequently, in the mode of football training, at the very initial stages of training process the highest values of aerobic performance are demonstrated by the representatives of mesomorphic constitutional type; on the contrary, the representatives of brachymorphic constitutional type have the lowest values of aerobic performance. In the course of longstanding training process of the football players, the difference in values of aerobic performance between the M-type and D-type representatives becomes insignificant. The representatives of B-type bodybuild have also the lowest values of aerobic performance of the body.

Young basketball players aged 10-12 showed no reliable differences in values of aerobic performance between the representatives of M-type and D-type of constitution; however, VO\textsubscript{2} Max values of the M-type representatives were slightly higher. The representatives of B-type bodybuild had significantly lower values of aerobic performance. VO\textsubscript{2} Max values of young M-type basketball players were reliably lower than the values of young football players of the same age, and there were no reliable differences in such values between the representatives of D-type and B-type.

In the age period of 13-15 years, young basketball players of D-type bodybuild revealed the highest values of aerobic performance shown in Table 1. Young B-type basketball players had the lowest aerobic performance. The difference in VO\textsubscript{2} Max values was significant in such case (p<0.05). On the contrary, the representatives of B-type bodybuild among young football players and basketball players had significantly lower values of aerobic performance than their peers – representatives of D-type and M-type bodybuild. At the same time, the representatives of all constitutional types revealed a reliable increase in VO\textsubscript{2} Max value as compared to the age period of 10-12 years. Comparison of aerobic performance of young basketball players and of football players of the same age demonstrated that VO\textsubscript{2} Max level was reliably lower (p<0.05) than relevant VO\textsubscript{2} Max value of young football players of such type.

VO\textsubscript{2} Max value in young basketball players of B-type was insignificantly higher than the relevant value of young football players of such constitutional type. The representatives of B-type bodybuild had the lowest values of aerobic performance of a body during all stages of the training process.

D-type bodybuild students playing basketball revealed the highest values of aerobic performance. B-type basketball players had the lowest aerobic performance.

Comparison of aerobic performance of students engaged in regular sports activities demonstrates that the M-type students playing basketball had the highest VO\textsubscript{2} Max values. VO\textsubscript{2} Max value of D-type students engaged in regular basketball training was higher than relevant value of dolichomorphs going in for other sports.

It should be noted that the trend toward development of the highest VO\textsubscript{2} Max values was traced in the representatives of M-type and D-type. All representatives of B-type had reliably lower VO\textsubscript{2} Max values.

Somatotypological diagnostics revealed that dolichomorphic type was predominant in basketball students' group, while football players were mostly of mesomorphic constitutional type.

4. Discussion

Data accumulated in sports constitution science carry inference that representatives of many sports
specializations are characterized with their own way of
distribution of somatotypes with apparent predominance
of one of them differing from the representatives of
other specializations and general population9. This fact
confirms our opinion that a somatotype is a “selective
factor” in different sports.

However, there are no concurrent views as to the
reasons for morphological differences between athletes
of different specializations. Some researchers believe
that the effect of sports exercises is the reason for such
differences10, while other researchers find that the
combined effect of such factors is the main reason11,12. We
consider those researchers, who insist on the combined
effect of peculiar sports physical exercises and selection,
to be more right1.

Some researchers believe that somatotypical analysis
allows deciphering the mechanism of intragroup
peculiarities of the functional state of a body and the level
of its adaptive capabilities13-15.

A comprehensive approach to somatotypological
and functional characteristics in examination of the
effect of sports physical load on bodies of children,
adolescents and students is a real way of reasonable
arrangement of an educational and training process and
successful preparation of athletes, which allows setting
regulatory standards in compliance with capabilities of
the people engaged in sports activities. It is necessary
for the individualized approach in sports activities and
development of optimum training mode.

VO2Max is one of the integral indicators of working
capacity, aerobic performance, general stamina and
level of physical development. In the age periods of 10-
12 and 13-15 years, the highest values of VO2Max were
shown by football players. Football players demonstrated
higher VO2Max values than basketball players among the
students engaged in sports activities in sports groups.

This is consistent with the data found in literature on
the higher VO2Max values of young football players as
compared to basketball players and non-athletes14.

Analysis of VO2Max values in view of a somatotype
shows that VO2Max values of mesomorphic football
players are significantly higher than VO2Max values of
the representatives of dolichomorphic and especially
brachymorphic constitutional types. On the contrary, in
case of basketball players, high VO2Max values are typical
of the representatives of dolichomorphic type.

The representatives of brachymorphic constitutional
type had the lowest values of aerobic performance. This
group is risky, since such level of functional capabilities
of the body is achieved by significant decrease of reserve
capabilities and tension of regulatory systems, which
may result in disruption of adaptation. In this respect,
the representatives of B-type of constitution engaged in
football activities are of the biggest concern.

Differences in the level of physical fitness between
the representatives of different sports having the same
somatotype evidence the relation between the functional
and adaptive capabilities of the body and the nature
of sports physical loads in football and basketball.
Respectively, these reasons explain different development
of training response subject to the value of the operating
factor.15-18

Generally, the research showed that determination
of a constitutional type of athletes and assessment of
aerobic performance of the body form a unified set of
information, on the basis of which adequate and
personalized recommendations can be developed, which
result in optimization of motional modes for a particular
group of exercisers.

5. Conclusions

Determination of the athletes’ constitutional type and
assessment of aerobic performance of the body make a
unified set of information, on the basis of which adequate
and personalized recommendations can be developed,
resulting in optimization of motional modes for a
particular group of exercisers.

The representatives of M-type bodybuild
demonstrated highest values of body stamina (VO2Max)
among football players of all age periods and basketball
players of second childhood and adolescence age period.
In case of basketball players of the preadult age, high
VO2Max values are established in the representatives of
the dolichomorphic type.

The representatives of the brachymorphic
constitutional type, having low VO2Max values, form a
risk group in both sports. Any breach of sports training
regime may result in exhaustion and different disorders
in such persons, accompanied with deterioration of
health, and in some cases they may lead to disruption
of adaptation. Recognition of individual typology is a key
point for planning training loads.
6. References


