

STUDIES IN PHYSICAL CULTURE AND TOURISM
Vol. 13, Supplement, 2006ROBERT ŚLIWOWSKI¹, MARIA LAURENTOWSKA², EDYTA MICHALAK², ANDRZEJ WIECZOREK¹,
JACEK WIECZOREK¹¹Department of Team Sports Games²Department of Physiology, University School of Physical Education in Poznań, Poland**CHANGES IN ANAEROBIC PERFORMANCE IN YOUNG FOOTBALL PLAYERS
IN AN ANNUAL TRAINING CYCLE**

INTRODUCTION

In physiological diagnosing of the trainedness status in football the key role is played by properly selected physiological indicators used for standardisation of criteria and methods of assessment of exercise ability. In reality the majority of this type of studies relate to aerobic performance. The above problem is definitely less studied and documented in the case of anaerobic performance, in particular in young players. Most of these experiments have been most often limited to one-off, fragmentary studies of little diagnostic value for practical training.

Taking into account the above the main aim of the study was to assess the range of changes in selected physiological indicators characterising anaerobic performance in young football players.

METHODS

A group of 15 football players aged 14-15 years from the Wielkopolski Klub Piłkarski (the Wielkopolska

Football Club) was examined. Laboratory tests were carried out five times (30-second Wingate test); the dates of the tests were determined by the time structure of the analysed macrocycle: January – the 1st date of examinations before the beginning of the main preparatory period, March – the 2nd date of examination at the end of the main preparatory period and the beginning of the spring starting period, June – the 3rd date of examinations at the end of the spring starting period, September – the 4th date of examinations at the end of the shortened preparatory period and the beginning of the autumn starting period, November – the 5th date of examinations at the end of the autumn starting period.

In order to verify the statistical hypotheses non-parametric tests were used: the ANOVA-Friedman's analysis of variance and Wilcoxon's test.

The biometric characteristics of the subjects were presented in Table 1.

Table 1. Anthropometric characteristics and training experience of the studied players of the WKP "Lech"

EXAMINATION	N	Mean values of the studied characteristics				
		Calendar age [years]	Height [cm]	Weight [kg]	BMI [kg·m ⁻²]	Training experience [years]
I	15	14.8	170.7	58.4	19.9	4.9
II	15	14.9	171.1	58.5	19.9	5.0
III	15	15.2	172.1	60.0	20.2	5.3
IV	15	15.4	173.1	61.5	20.4	5.5
V	15	15.6	174.5	63.6	20.8	5.7

Correspondence should be addressed to: Robert Śliwowski, Department of Team Sports Games, University School of Physical Education, ul. Chwiałkowskiego 38, 61-553, Poznań, Poland, e-mail: r.sliwowski@lech.poznan.pl

RESULTS

In the analysis of the changes of absolute and relative values of maximum power (M_{\max}) and the values of performed work (P) and mean power (M_{sr}) in players of the MKP "Lech" it was found that the changes had an identical unidirectional course characterised by a stable increase of their values during examinations on subsequent dates. The greatest increase of absolute values of maximum power occurred between the examinations on the 1st and 2nd dates ($p < 0.01$) and 4th and 5th dates ($p < 0.05$) (Table 2). In the case of absolute values of this indicator significant increases were noted only between examinations of the 1st and 2nd dates ($p < 0.01$, Table 2). The greatest difference in absolute values of the performed work and mean power (Table 2) was noted between examinations on the 1st and 2nd, 2nd and 3rd and 4th and 5th dates. In both cases significant differences occurred at the level of $p < 0.01$. In terms of relative values of performed work significant differences ($p < 0.01$) were noted only between examinations on the 1st and 2nd dates.

No unidirectional changes were found in the level of other mechanical indicators. Hence, the longest time of reaching maximum power (t_{uz}) was registered during the examination on the 1st date, and the shortest – beneficial for the footballers – during the examination on the 5th date (after the autumn starting period). A statistically significant difference in the above values was noted only between the examinations on the 1st and 2nd dates ($p < 0.01$, Table 2). The longest – beneficial for the footballers – time of maintaining maximum power (t_{ut}) was noted during the examination on the 2nd date (after the main preparatory period) and the shortest one – during the examination on the 5th date.

DISCUSSION

The cross-sectional data collected in the Wingate Institute [1] indicate that power and capacity of anaerobic energetic processes increase progressively during puberty until reaching the level appropriate for adults after the end of the second decade of life. The above developmental tendency is also reflected in some other continuous and cross-sectional studies carried out on young football players. Unidirectional development of maximum anaerobic power and general work measured using a 30-second Wingate test was observed by Śledziwski et al. [6] in an annual training cycle of 15-16-year-old footballers of "SEMP" Warsaw. An identical course of changes was also found in 16-year-old footballers of the SMS in an annual cycle of sports training [3]. The same author [3, 4] showed a gradual increase in the level of the above indicators in his analysis of groups of athletes at various stages of football training (from boys to seniors). Also the studies of other authors [5, 8, 9] confirm a gradual improvement in anaerobic potential of young football players with age and training advancement.

The author's own studies also confirm the above tendencies. Systematic development of anaerobic performance of young footballers of the WKP "Lech" along with the unidirectional increase in anthropometric indicators (Table 1) could be mainly determined by developmental processes in this phase of ontogenesis. Relative values of maximum power (M_{\max}) and work (P) achieved by players of the WKP "Lech" on the 5th date of examinations ($9.7 \text{ W}\cdot\text{kg}^{-1}$ and $239 \text{ J}\cdot\text{kg}^{-1}$, respectively, Table 3) referred to other young groups should be treated as average. The above mentioned cross-sectional studies of Żuchowicz et al. [9] indicate that the mean M_{\max} ranged from $9.5 \text{ W}\cdot\text{kg}^{-1}$ in the boys category to $11.3 \text{ W}\cdot\text{kg}^{-1}$ in the junior category. On the other hand,

Table 2. Characteristics of changeability in mechanical indicators obtained in a 30-second Wingate test in players of the WKP "Lech" between subsequent dates of examinations (values of the ANOVA-Freidman's test and Wilcoxon's test)

INDICATORS	ANOVA – Friedman's test	Wilcoxon's test				
		II – I	III – II	IV – III	V – IV	V – I
M_{sr} [W]	48.95**	3.351**	2.699**	1.534	3.010**	3.408**
M_{\max} [W]	35.68**	3.351**	1.079	1.249	2.556*	3.408**
M_{\max} [$\text{W}\cdot\text{kg}^{-1}$]	25.17**	3.010**	0.653	1.874	0.454	3.294**
P [kJ]	48.37**	3.237**	2.669**	1.534	2.953**	3.408**
P [$\text{J}\cdot\text{kg}^{-1}$]	23.88**	3.067**	0.377	1.099	1.381	3.237**
t_{uz} [s]	12.35*	3.067**	0.114	0.511	0.852	0.738
t_{ut} [s]	4.24	0.057	0.454	1.761	0.973	0.511

** $p < 0.01$ * $p < 0.05$

Table 3. Mean values of mechanical indicators obtained in a 30-second Wingate test by the WKP "Lech" players on subsequent dates of examination

INDICATORS		1 st examination	2 nd examination	3 rd examination	4 th examination	5 th examination
M_{sr} [W]	\bar{X}	416.93	456.33	477.47	488.00	503.60
M_{max} [W]	\bar{X}	508.00	563.33	578.53	585.07	624.07
M_{max} [W·kg ⁻¹]	\bar{X}	8.67	9.28	9.36	9.69	9.74
P [kJ]	\bar{X}	12.51	13.67	14.33	14.63	15.14
P [J·kg ⁻¹]	\bar{X}	213.33	228.67	229.73	233.47	239.13
t_{uz} [s]	\bar{X}	6.98	6.04	5.96	6.04	5.80
t_{ut} [s]	\bar{X}	4.64	4.74	4.65	4.02	4.31

mean work in another cross-sectional study [5] of footballers in the same age category (13 to 21 years) ranged from 235 to 290 J·kg⁻¹. Results similar to those noted in author's own study were obtained by Zieliński et al. [8] in 15-year-old players of the "SEMP" Warsaw. In this study it was found that mean M_{max} and P amounted to 9.3 W·kg⁻¹ and 227 J·kg⁻¹, respectively. Higher values of the analysed mechanical indicators (10.6 J·kg⁻¹; 261 J·kg⁻¹) were noted in 14-15-year-old players of the Polish National Team of Sub Juniors (Kadra Polska Młodzików) [2]. Significantly higher values of M_{max} , of 11.5 W·kg⁻¹, were noted in players of the Polish Football Association Olympic Team (Kadra Olimpijska PZPN) [2]. Their mean work was 274 J·kg⁻¹. According to Śledziwski [7] performing by 1st league footballers work exceeding the value of 270 J·kg⁻¹ and achieving M_{max} above 11.7 W·kg⁻¹ indicates a very good condition in terms of anaerobic performance – for the needs of playing football. However, exercise standards for senior footballers presented recently by Jastrzębski [4] (empirical data collected from 164 footballers representing a high level of sports proficiency) indicate that – according to the standards of values from good to very good adopted here – in terms of maximum power (M_{max}) the players should be characterised by results within the range of 12.4-13.2 W·kg⁻¹, and in terms of indicators of performed work (P) 299-314 J·kg⁻¹.

Average, in relation to comparative youth teams and low compared to seniors, values of basic indicators of anaerobic performance achieved by the players of WKP "Lech" may indicate a low range of applied training loads in terms of intensity.

REFERENCES

- [1] Inbar O., Bar-Or O., Anaerobic characteristics in male children and adolescents, *Med. Sci. Sports Exerc.*, 1986, 18: 264-269.
- [2] Jastrzębski Z., The assessment of anaerobic performance in footballers, *Med. Sportowa*, 2000, 103: 5-8.
- [3] Jastrzębski Z., The assessment of physical efficiency and selected tests of motor fitness in footballers in an annual training cycle, *Med. Sportowa*, 2002, 18: 82-87.
- [4] Jastrzębski Z., An attempt to establish standards for selected mechanical indicators in the Wingate test of footballers, (in:) H. Sozański, ed., *Trening sportowy na przełomie wieków*, AWF, Warszawa 2002, 176-180.
- [5] Łuszczuk M., Jastrzębski Z., The assessment of selected indicators of aerobic and anaerobic performance in footballers of various age groups. Summary from an international scientific conference: "Social and cultural and biomedical aspects of football of young people in the context of European integration", Kraków 29.04-01.05.2004., *Med. Sportiva*, 2004, 8 (1): S239-S240.
- [6] Śledziwski D., Zieliński A., Tyc Z., Kapera R., Effectiveness of training of young football players with the example of SEMP Warsaw club, *Trening*, 1999, 2-3: 96-102.
- [7] Śledziwski D., Checking the level of fitness preparation of footballers, *Trener*, 2001, 4: 11-16.
- [8] Zieliński A., Śledziwski D., Tyc Z., Anaerobic performance of footballers of selected league teams, (in:) A. Stuła, ed., *Modern football. Theory and practice*, Materials from the Scientific and Methodical Conference, Gorzów Wlkp. 28-29.05.1999, 85-90.
- [9] Żuchowicz A., Cempla J., Maciejczyk M., Kobosko W., Indicators of anaerobic potential of young football players of top Cracow clubs – comparison of players representing various age categories. Summary from an international scientific conference: "Social and cultural and biomedical aspects of football of young people in the context of European integration", Kraków 29.04-01.05.2004., *Med. Sportiva*, 2004, 8 (1): S254-S255.