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Effects of tennis training on aerobic and anaerobic capacity in young tennis players

Zmiany wydolności tlenowej i beztlenowej w procesie treningowym u młodzieży trenującej tenis

Tennis is one of the most attractive and currently popular "lifetime sports" and the number of young tennis players is constantly growing. The age of beginning to train tennis in last years decreases. Young tennis player are involved in competition take part from an early age on. Training should prepare to this specific exercise. Tennis matchplay is primarily characterized by acyclic short time intermittent workloads of the body`s muscular system with mainly extensive and partly intensive work phases (Bergeron, 1991, Elliott 1985, Ferrauti 2001) Aerobic and anaerobic endurance are regarded the second most important conditional factors after speed and agility by tennis coaches (Ferrauti 2002).

It is known that metabolic responses to heavy exercise are different in young players and adults. In particular, young people have lower anaerobic performance compared with adults (Armon at al.,1991). Anaerobic and aerobic performance continuously increases through-out the various growth. Although tennis is characterised by periods of high –intensity exercise –the overall metabolic response resembles prolonged moderate-intensity exercise (Bergeron, 1991).

Due to this our purpose was to observe:

- oxygen uptake in period of three years of growth in 12-14 years old boys
- changes in anaerobic power in this group

MATERIALS AND METHODS

Eight boys were tested in period of 12-14 their age. They played tennis 5 times a week . Every years in preparing phase of training each subject performed two tests. First test was incremental cycling exercise to volitional fatigue on cycloergometer Monark.

We determined main aerobic components: values of VO_2 max in ml. $kg^{-1}.min^{-1}$ and values of anaerobic threshold (AT) expressed in % VO_2 max using gas analyser EOS SPRINT Jaeger. The second was 30s Wingate test on introduced by Bar-Or in which the exercise is performed on the cycloergometer at a maximal rate from the onset of exercise.

The date are presented as the mean ±standard deviation. Statistical analysis was carried out using analysis of variance (ANOVA).

RESULTS

The anthropological parameters of examined subjects are shown in table 1. Parameters of aerobic and anaerobic capacity are shown in table 2 and 3. In this period of time their weight and fat free mass has been changed about 53 % . Fat mass increased only 4%. Aerobic capacity expressed in maximal oxygen consumption was changed but not like we suspected.

This improvement was observed , when maximal oxygen consumption was expressed in l/min, but the result was opposed when maximal oxygen included body mass of subjects. Differences were significant. Parameters, which characterises anaerobic capacity, have increased in this period of time. The interesting fact was growing fatique index, which was observed in this time.

Table 1. Anthropometric characteristics of boys

Age of testing	Weight [kg]	Height [cm]	% Fat	Fat mass [kg]	Fat free mass [kg]]
I – 12	42,4± 2,3*	154± 5,3*	15,6± 1,6	6,7±3,4	35,7± 2,8*
II – 13	49,8± 3,5■	163± 6,3■	12,3± 3,5	6,1± 1,8*	43,7± 4,1■
III – 14	65,0± 3,9*■	174± 4,8*■	15,5± 3,9	10,1± 3,7*	54,9± 5,3*■
	*p<0,001 ■ p<0,01	*p<0,01 ■ p< 0,05		*p<0,05	*p<0,01 ■ p<0,002
Values are mean ± SD, * ■ statistical differences					

Table 2. Aerobic capacity measurements in boys

Age of testing	VO_2 max L/min	VO_2 max [ml/min/kg]	AT [%VOmax]	AT in HR	HRmax b/min	Power Wat	Power Wat/kg
I – 12	2,4±5,1	58,3±2,1*	79,2±4,2	172±4*	194±4	160±11,2*	3,7±0,5*
II – 13	2,7±1,2	55,6±2,6■	65,4±3,5	158±5	189±2	210±13,5■	4,2±0,9
III– 14	2,7±0,7	44,1±3,9*■	58,8±7,0	150±9*	182±6	273±20,8*■	4,5±0,7*
		*p<0,001 ■ p<0,002		p<0,01		*p<0,002 ■ p<0,05	p<0,002
* ■statistical differences							

Table 3. Anaerobic capacity measurements boys

Age of testing	Total work [kJ]	Total work [J/kg]	Power max [W]	Power max [W/kg]	Fatique index %	Time 1 [s]	Time 2 [s]
I – 12	9,07±3 ■	214±18,3■	354±58■*	8,34±4,1■	17±3,2	6,14±2,1	5,23±0,4
II – 13	10,8±2,5*	200±25,3*	572±140*	10,4±1,4*	12±2,5■	5,20±1,4	6,60± 0,3
III– 14	17,8±6,3*■	275±19,2■*	730±35■	11,2±2,7■*	22±2,1■	4,40±2,1	4,33±1,2
	*p<0,05 ■ p<0,001	*p<0,01 ■ p<0,002	*p<0,05 ■ p<0,001	*p<0,001 ■ p<0,002	■ p<0,01		
Time 1- time in which power max was attained Time 2- time of sustaining power max							
* ■statistical differences							

Table 4. Maximum oxygen consumption of elite Dutch tennis players (Keul, 1991)

Number of subjects	Age group	VO_2 max [ml/min/kg]
N=11	12	61,6±3,2
N=15	13	61,2±5,6
N=18	14	62,9±4,8

DISCUSSION

The fact is that young people have lower anaerobic performance. It is depend on small activity of muscle glycolitic enzymes proportional to ages. It is suggest that at this age they can quickly adapt their oxidative metabolism meet the higher energy requirements and have a lower need for nonoxidative metabolism in the short-term, high-intensity exercise. We can observe this metabolic response at 12 years old. It`s correlated with their high aerobic capacity. In this period of time our results were similar , which was purposed by Keul , table 4 (Keul, 1991). This comparative study presented maximum oxygen capacity of top tennis players in Germany and Holland. The level of aerobic capacity in our tennis players at 14 of their age decreased dramatically. One reason of this fact was increasing of

body mass and the second was an inappropriate proportion between specific and conditional training in total of workload training. Workload, which was using promote develop of anaerobic parameters.

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SUMMARY

Tennis is one of the most attractive and currently popular “lifetime sports” and the number of children tennis player is constantly growing. The age of beginning to train tennis in last years decreases. Training should develop all . important conditional factors in tennis : aerobic and anaerobic capacity and speed and agility. Training should prepare to specific exercise and match play but it can`t concentrate on specific tennis training drills especially in young people The physiological demands of tennis are quite complex of endurance , sprint and strength. Aerobic and anaerobic endurance are regarded the second most important conditional factors after speed and agility by tennis coaches The aim of this study was to observe oxygen uptake in period of three years of growth in 12-14 years old boys and girls, determinate changes in anaerobic power in this groups. We determined main aerobic components: values of VO_2 max in ml. $kg^{-1}.min^{-1}$ and values of anaerobic threshold (AT) expressed in % VO_2 max. Anaerobic components we exanimate using maximal exercise introduced by Bar. The date are presented as the mean ±standard deviation. Statistical analysis was carried out using analysis of variance (ANOVA). This results indicate that special tennis training was dominating in this period of age and training

STRESZCZENIE

Tenis należy do jednej z najbardziej popularnych dyscyplin sportowych. Liczba trenującej młodzieży stale ulega zwiększeniu, z kolei wiek rozpoczęcia procesu treningowego obniża się. Proces treningowy powinien kształtować wszystkie elementy: zdolności motoryczne (wytrzymałość, siła, szybkość, koordynację ruchową) oraz wydolność tlenową i beztlenową. Proces treningowy w wieku rozwojowym powinien brać pod uwagę wszechstronny rozwój trenujących Fizjologiczne wymagania w tenisie są kompleksem wytrzymałości , szybkości i siły. Istotnym czynnikiem w procesie treningowym jest zachowanie właściwych proporcji między treningiem specjalistycznym, a wszechstronnym. Celem pracy była ocena kierunku zmian parametrów wydolności tlenowej i beztlenowej chłopców pod wpływem procesu treningowego w tenisie ziemnym. Badania zostały przeprowadzone w okresie biologicznego rozwoju chłopców od 12 do 14 roku życia. W pracy dokonano pomiarów antropometrycznych i fizjologicznych badanych. Oceny wydolności tlenowej badanych dokonano w oparciu o bezpośrednią próbę wyznaczenia maksymalnego poboru tlenu, natomiast do oceny wydolności beztlenowej zastosowano test Wingate, wersję 30 s. Uzyskane wyniki wskazują, iż proporcje treningu specjalnego do wszechstronnego były w badanym czasie wyższe w ogólnym procesie treningowym. Zmiany parametrów wydolności anaerobowej wskazują, iż stosowane obciążenia treningowe prowadziły do zwiększenia szybkości i siły. Parametry wydolności tlenowej badanych są niższe niż proponowane przez Międzynarodową Federację Tenis ITF dla tych kategorii wiekowych. Zastosowane obciążenia treningowe w badanej grupie nie utrwaliły wzrostu wydolności tlenowej badanych, mierzonej wartością maksymalnego poboru tlenu.