THE EFFECT OF PHYSICAL PREPARATION ON AEROBIC AND ANAEROBIC FITNESS IN ICE HOCKEY PLAYERS

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Key words:
- Aerobic capacity.
- Anaerobic power.
- Preparatory period.
- Ice hockey.

Abstract:

The study deals with partial findings making part of the research project VEGA No. 1/1020/11 targeted at the variability of aerobic and anaerobic fitness in athletes throughout the annual training cycle. The purpose of the present study was to determine the effect of physical preparation on functional parameters of aerobic and anaerobic fitness in ice hockey players. The sample consisted of 9 ice hockey players aged 15-16 on the ice hockey team P.H.K. Prešov. Aerobic fitness was measured using both field-based Beep test and laboratory-based spiroergometric test W_{170} on bicycle ergometer. Both tests were used to determine maximal oxygen uptake. Anaerobic fitness was measured using 30-second Wingate test performed on the cycle ergometer Monark 894E. Players were tested for the parameters of peak anaerobic power, average anaerobic power and fatigue index. The results showed that maximal oxygen uptake increased upon the completion of the physical preparation as indicated by the results of spiroergometric test and field-based Beep test. The level of anaerobic fitness decreased as evidenced by decline in peak anaerobic power and average anaerobic power.

INTRODUCTION

Off-ice conditioning, which is a part of ice hockey team training, develops motor preconditions that determine performance capacity of the players [1,12]. Preparation period training focuses on the development of limiting motor abilities and forming of a broad motor basis [9]. Off-ice conditioning contains exercises that focus on the development of speed, speed strength, strength, strength endurance, endurance and coordination abilities [8]. Based upon the physiological profiles of ice hockey players it is possible to confirm the importance of aerobic endurance, anaerobic performance, strength endurance, flexibility and skating speed [7,13]. Regarding the special training preparation phase, the age of juvenile youth is in professional sports characterized as a demanding phase, both mentally and physically. It is this period when the performance is greatly emphasized and the training is as demanding as that of adults [5].

MATERIAL AND METHODS

The aim of the research was to verify the effect of controlled conditioning on both functional and performance-related parameters of aerobic and anaerobic abilities of selected ice hockey players during preparation and pre-season period. The observed group consisted of 9 youth ice hockey players of P. H. K. Prešov hockey club, averaging 15.66 ±0.5 years of age. The players trained regularly 5 times a week, with a training unit lasting 75 to 105 minutes. The training process during the preparation period lasted for 9 weeks and had a character of

general off-ice training. Pre-season period lasted for 6 weeks, and the training process had a character of a specific on-ice preparation, supplemented with a few training units off the ice. During this period the players played 11 pre-season matches. The aerobic abilities were tested by the laboratory spiroergometric test on a bicycle ergometer to volitional exhaustion and also by field-based running Beep test. Maximum oxygen consumption (VO_2max) was a parameter monitored in both tests. The anaerobic ability testing was carried out by means of the 30-second Wingate test, using a bicycle ergometer Monark 894E. Peak power ($PP.kg^{-1}$) and average power ($AP.kg^{-1}$) were the parameters monitored this time. The training intensity during the preparation and pre-season period was monitored by the Polar heart rate monitors. Based upon the recorded pulse rates we were able to better specify the training zones of players during the preparation training period. We used the median and quartile range, and the collected data were processed via non-parametric statistics of Wilcoxon test for dependent samples. The collected data are presented in relative values, calculated relative to kilogram body mass.

RESULTS AND DISCUSSION

Aerobic capacity is measured by maximum oxygen consumption (VO_2max). Ice hockey players should be at about 50 – 70 $ml/kg.min^{-1}$ [1]. Optimal VO_2max values should be around 60 $ml/kg.min^{-1}$, with the top level players reaching 65 $ml/kg.min^{-1}$ [3]. Due to the specific kinetic character and muscle group recruitment of ice hockey players, it is more common to use bicycle ergometer testing. When using a running treadmill testing, more active muscles are employed in the activity than when using a bicycle ergometer, hence the levels of VO_2max determined using a running treadmill are 7-8% higher [8].

Table 1 Basic descriptive characteristics and significance of differences of VO_2max values during monitored training phases

	Input ($ml/kg.min^{-1}$)	**Preparation period ($ml/kg.min^{-1}$)**	**Pre-season period ($ml/kg.min^{-1}$)**
Median	49	52.7	56.7
Quartile range	4.6	8.4	4.5
Value T	**Input – preparation period**	**Preparation period – pre-season period**	**Input – Pre-season period**
	0.0*	21.5	3.0*

Legend: $p < 0.05$*, $ml/kg.min^{-1}$ – milliliter per kilogram body mass per minute

Basic characteristics and significance of differences are to be found in the Table 1. The selected group achieved median value VO_2max at the beginning of preparation period 49 $ml/kg.min^{-1}$. Following a 9-week general training the group recorded an increase of median to 52.7 $ml/kg.min^{-1}$. When comparing the two, the increase of VO_2max equals 3.7 $ml/kg.min^{-1}$. Following a 6-week specific training we recorded a statistically insignificant VO_2max increase of just 4 $ml/kg.min^{-1}$. The effect of general and specific training on maximum oxygen consumption was statistically significant. Players did not reach the bottom level of VO_2max 50 $ml/kg.min^{-1}$ at the beginning of training, recommended for ice hockey players. The VO_2max 56.7 $ml/kg.min^{-1}$ level upon completion of specific training was close to the optimal VO_2max 60 $ml/kg.min^{-1}$ level, recommended for ice hockey players [3]. Beep test was devised as a simulation of the graded spiroergometric treadmill test or bicycle ergometer.

Table 2 Basic descriptive characteristics between performances achieved in Beep test during monitored training phases

	Input (ml/kg.min^{-1})	**Preparation period (ml/kg.min^{-1})**	**Pre-season period (ml/kg.min^{-1})**
Median	55.1	57.0	57.73
Quartile range	2.0	3.5	2.58
Value T	**Input – preparation period**	**Preparation period – pre-season period**	**Input – Pre-season period**
	8.0	9.0	12.0

Legend: ml/kg.min^{-1} – milliliter per kilogram body mass per minute

Input value of VO_2max based on Beep test was 55.1 ml/kg.min^{-1} (Tab. 2). Following a 9-week general training we recorded a statistically insignificant increase of VO_2max of 1.9 ml/kg.min^{-1}. Following a 6-week specific training we recorded a statistically insignificant increase of VO_2max of 0.73 ml/kg.min^{-1}.

Table 3 Basic descriptive characteristics and significance of differences between peak anaerobic power during monitored training phases

	Input (W/kg)	**Preparation period (W/kg)**	**Pre-season period (W/kg)**
Median	11.6	10.9	11.06
Quartile range	1.7	1.2	1.43
Value T	**Input – preparation period**	**Preparation period – pre-season period**	**Input – Pre-season period**
	2.0*	11.0	10.0

Legend: W/kg – Watt per kilogram body mass, $p < 0.05$*

Basic descriptive characteristics and significance of differences between values of peak anaerobic power are shown in Table 3. At the beginning of training the peak anaerobic power of the players was 11.6 W/kg. Following a 9-week general training we recorded a statistically significant maximum anaerobic performance decrease of 0.7 W/kg. Following a 6-week specific training we recorded a statistically insignificant increase in peak anaerobic power by 0.16 W/kg. An interesting finding was that after the 6-week pre-season period we recorded a decrease of peak anaerobic power in comparison to the baseline level of 0.54 W/kg. Heller [4] reported in his study that peak anaerobic power, achieved by 15-year old Czech league players was 13.3 ±1.4 W/kg. In a study carried out by Šťastný, junior players who successfully established themselves in senior ice hockey achieved maximum anaerobic power between 15.1 and 16 W/kg [11]. Potteiger et al. [10] reported that peak power of 20-year-old players was 14.7 ±1.5 W/kg. The difference between the tests was that the players were allowed to pedal even when standing. Gacesa et al. [2] carried out a study of 20 year old players after a preparation period, and the players achieved maximum performance level of 10.14 ±2.26 W/kg. The peak anaerobic power is a more specific parameter for ice hockey when compared to the average anaerobic power. It represents the ability of organism to produce energy necessary for muscle activity, while utilizing high-energy substrates, whereas the average anaerobic power is an indicator of glycolytic capacity [6]. The higher the peak anaerobic power the better energetic pre-conditions for an explosive, accelerative, maximum strength and speed.

Table 4. Basic descriptive characteristics and significance of differences between average anaerobic power during monitored training phases

	Input (W/kg)	Preparation period (W/kg)	Pre-season period (W/kg)
Median	9.5	9.0	8.98
Quartile range	0.3	0.6	0.45
Value T	**Input – preparation period**	**Preparation period – pre-season period**	**Input – Pre-season period**
	0.0*	3.0	6.0

Legend: W/kg – Watt per kilogram body mass, $p < 0.05$*

The ice hockey players achieved the average anaerobic power of 9.5 W/kg (Tab. 4) at the beginning of the training period. Following a 9-week general training we recorded a statistically significant decrease of 0.5 W/kg. Following a 6-week specific training we recorded a statistically insignificant decrease in average anaerobic power 0.02 W/kg. When compared to the findings of Potteiger et al., the monitored players achieved the same level of an average anaerobic power at the beginning of the training period as the 20-year old juniors – 9.5 W/kg. In case of average anaerobic power the rule applies that the higher the average power the higher the pre-conditions of an individual for speed and strength endurance [10].

COCNLUSIONS

The aim of the research was to verify the effect of condition on both functional and performance parameters of aerobic and anaerobic abilities of monitored ice hockey players during a preparation and pre-season period. After a thorough assessment of the effect of conditioning we can acknowledge a statistically significant influence on maximum oxygen consumption only in case of the laboratory spiroergometric testing. In the ground Beep test the increase of VO_2max recorded was statistically insignificant. In case of the peak anaerobic power we recorded a statistically significant decrease following the general conditioning preparation, with the similar findings applying for the average anaerobic power, when a statistically significant decrease was also found following the general conditioning preparation phase.

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