MIDDLE-DISTANCE RUNNERS' TRAINING STRUCTURE DURING PREPARATION PERIOD AND ITS INFLUENCE ON VO2MAX AND LT

Maciej **KURYLAS**

Academy of Physical Education in Katowice

Key words:

- middle distance,
- running,
- lt threshold,
- vo2max,
- training tools.

Abstract:

Introduction: In the middle-distance runningdiversity and variety of the training techniques makes theverifying the resultsof training the most important aspect to focus on.

There is a very important theoretical discussion taking place amongst the trainers and researchers, but the real need is for an empirical and based on scientific proof training methodology.The effectiveness of the training on every single step of the yearly training schedule should be the main focus of any scientific research.

This study describes two different approaches and training concepts. The first one focuses on the capacity, and the second one on the intensity of training. Both conceptsconcentrateon the preparation period for the runners and focus on the stamina of middle-distance sports,taking into account Vo2max and LT threshold.

The objective: The goal and main objective of this research is to analyze and register the pressure that the middle-distance runners are undertaking. The results will then be compared with the results of the home based running track test, whilst the Vo2max and LT threshold will be altered accordingly.

The research and methodology: The focus group consists of two middle-distance runners. Their results can be classified as 1st class runners on both 800 and 1500 meter distances. Both runners are supervised by two trainers representing a different training approach. The trainings were independent and not linked with one another. Before and after the 2 months of training there was a test undertaken whilst Vo2max and LT thresholds were recorded. Both attempts took place on a racing track with the same inclination angle. The results and training loadings were recorded in a training diary. The intensity of the training was calculated using the following formula: the indication of the percentage of runners' distance in kilometres over the LT threshold - defined during the first test and compared with entire training capacity during the training period.

Results: The results are showing that the training of a runner with the intensity over 33% of the LT threshold compared with the overall capacity, gives the improvement of Vo2max and LT threshold (+ 6 mm/l/kg mc, + 4 HR for the load). The training with 281 km extension in two months over the initial distance and with lessen LT threshold (-16) results in increase in Vo2max and decrease of LT threshold (+ 6 mm/l/ kg mc, - 2 HR for the load).

Conclusion: The final results are proving that in B group sports,during the preparation period, more intense work is more efficient,at the same time lessen capacity of the training needs to be maintained.

1.INTRODUCTION

Training structure in group B - moderate dynamic sports, has the most diversified training methodology. This is mostly caused by the complexity of this training (Sobczuk). Whilst analyzing the middle-distance running training techniques we can observe the diversity in the approach towards capacity and intensity of the training. Same applies to looking into the macrocycle when the runners work over their LT threshold.

One of the most commonly used training techniques is the dynamic exercise of progressively increasing workload to maximal oxygen consumption test, also known as the maximum effort test. The above mentioned takes into account lactate levels.The tool is normally used to assess the runner's preparation for the incoming event, and also as a useful instrument to prepare and build training schedule and training structure (Bilat, Durocher).Most researches based on the dynamic exercise of progressively increasing workload to maximal oxygen consumption are taking into account LT changes and Vo2max. Those studies however are basing their results on team games (Wang, Durocher, Farina). Researchers are focusing on the changes of LT and Vo2max for the main players - the best performers. There is a lack of such research focusing on the middle-distance runners. There are no studies covering the changes in LT or Vo2max levels for middle-distance runners. Nowadays, training structure is analyzed with the assistance of coding of the training methodology (Sozański), or otherwise focusing on a case study when a particular runner is being analyzed (Prusik). Both methods are open to errors and mistakes when the training tool is classified incorrectly (the classification groups are as follow: general, directional and special). Middle-distance running in sports classification is logged as group B - moderate dynamic sports. This simply means that the training division amongst different training tool groups is much more complex. This always results in taking the researcher's thesis partially for granted. The only objective method would be to base the study on a physical parameters (Vo2max, LT)of a particular runner. Mesocycle preparation is the less researched step of the training macrocycle. All studies dealing with training structure are mainly focus on a macro level. The mesocycle is then treated as a part of macrocycle and analyzed as a part of the whole schedule. (Prusik) The other type of scientific studies are focusing only on the preparation mesocyclestep (Mleczko). There is a strong opinion amongst the trainers that only the training in the preparation mesocycle guarantees the best possible outcomeduring the BPS (direct preparation phase). In this study the research is based on a detailed and specific analysis of the mesocycle training taking into account physiological data (Vo2max, LT) andtraining structure for the two middle-distance runners. To fully describe the intensity of the training thestudy uses an innovative methodology indicating the percentage of the kilometresrun over the LT threshold during the first test, and compares the result with the training capacity during the entire training session. This research is a pilot for a research project named 'Adaptation to the changing training impulses in sports'. The study shows the importance of searching for the most efficient training methodology for the middle-distance runners.

2. RESEARCH AND METHODOLOGY

2.1The runners

The subject of this study are two middle-distance runners being described in the table below:

Table 1. The runners. Characteristics

INITIALS	(KG/CM)	TRAINING EXPE-RIENCE (YR)	Best running result		Sport classification
			800m	1500m	
J.O	66,1/176	8	1:51;56	3:54;3	I
M.J	70,5/182	9	1:53;26	3:48;9	I

The runners in question are representing two sport clubs in Silesia region. They have two separate trainers. Both are preparing for the national competition 'Junior Championship'. Both runners declare a willingness to run two distances: 800m and 1500m. They are yet to decide the main distance basing on their best results.They also have a very similar training experience. Both runners have been training under the same trainer's supervision thorough their careers. None of the runners have experienced any injury during their career. At least not one that would cause long term training suspension.During the training session - mesocycle - they did not experience any injuries. The entire training went as initially planned. The only changes to the training schedule were caused by the runners reaction to the training.

2.2 Research and methodology

Research type and methodology in the study may be difficult to define at first. Sport sciences are cross-disciplinary, same applies to the sport training studies.

The main subject of this study is the structure of the sport training, and the change observed in the training efficiency based onphysiological parameters. Sport training structure is very complex. The best and probablythe only way to study this and understand the complexity of sport training is to use a small study group. In this study there was an experiment used along side with case study, whilst an individual is being observed and analyzed. The dependent variable being explained is threshold of the LT (lactate threshold)and the maximal oxygen uptake (Vo2max) measured twice during the progressive test. The independent variable that will describe changes in LT and Vo2max is 9 weeks long mesocycle preparation for the runners in question. What's also important is the fact that the training structure for each trainee was built and designed by trainers independently. Trainers had a full autonomy in creating of the structure and schedule. The actual result of the training isbased solely on the different approach towards the training amongst those two trainers. This enables us to describe more individual training aspects.

2.3 Classification of the training tools

Dynamic exercise of progressively increasing workload to maximal oxygen consumption test enables description of the stress zones and LT threshold. Based on this, training tools were classified as: under the maximal oxygen uptake, below the maximal oxygen uptake, and lactate level test. Training structure is a very complex tool and the classification of the variables is being shown in the table below:

Table 2. Classification of the training tools.

Training tool	Pulse		Capacity factor
	M.J	J.O	
Jogging	<140	<135	Under the level of maximal oxygen uptake.
OWB 1	140-159	135-164	Under the level of maximal oxygen uptake.
OWB 2	160-171	165-175	Under the level of maximal oxygen uptake.
OWB 3	176-187	172-183	Under the level of maximal oxygen uptake/Above the level of maximal oxygen uptake.
WT	>188	>184	Above the level of maximal oxygen uptake.
WSz	Nm	Nm	Lacticacidlevel/capacity
Rythm	Nm	Nm	Lacticacidlevel/capacity
Runs	Nm	Nm	Lacticacidlevel/capacity
Skip, leap	Nm	Nm	Lacticacidlevel/capacity

In sport sciences there are multiple ways of classifying training tools in running (Sozański). In this study Sozański and Warsaw centre of sport studies' classification is being adapted here. Capacity factors used are solely based on the laboratory studies.

2.4 Registering and analyzing of the sports training

In this study training of two middle-distance runners was analyzed and registered. The training session lasted for 9 weeks' mesocycle. All data being used originates from the daily diaries of the two runners. Both runners were registering their results but also their pulse readings. This research is based on those results and both runners physical capacities. We can divide the training in various sports disciplinesinto: capacity and intensity training. The way that the training is registered and analyzed is well established in sports sciences. Training capacity is described as the amount of kilometres run (Sozański, Maciantowicz, Daniels, Bompa). In this study a global approach was introduced. An overall amount of the distance runwas taken into account, but the more specific results were also presented. We would also analyze microcycle of each runner. As well as the mesocycle of each runner.

The calculation of the intensity of the training is more controversial. In the study a percentage approach was adapted and introduced. Intensity is being described in an individual training session taking into account both: microcycle and mesocycle. This is then described in percentages and confronted with the entire levels of the maximal oxygen uptake and lactic acid level versus the entire training session physical stress load.

$$\text{Intensity} = \frac{(\text{above the level of maximal oxygen uptake LT[km]} + \text{lactic acid level[km]}) \times 100\%}{\text{entire training[km] (training capacity)}}$$

The very concept of describing the intensity of the training is an original concept designed by the author of this research. Only the runner's mesocycle prior to the direct pre-competition

training is being analyzed. In a very immediate stage of training we can observe a variety of oxygen uptake changes that would require a modification of the above presented equation.Also, a more precise approach towards LT wouldbe required.

2.5 Dynamic exercise of progressively increasing workload to maximal oxygen consumption test.

Dynamic exercise of progressively increasing workload to maximal oxygen consumption test is a scientific tool that provides reliable result regarding the maximum oxygen intake. (Górski 2011). When combined with a blood test after each exercise, and a close analysis of lactic acid levels,it provides a precise description of the capacity zones and oxygen uptake threshold. The runners in question were asked to take part in adynamic exercise of progressively increasing workload to maximal oxygen consumption test on a running track. Raise of body stress was then linked to the running intensity increase by 2km after each 3 minutes of running cycle. The inclination level remained the same through the test (Daniels 2010). During the exercise the runners were wearing masks allowing the measurement of their breathing, including Vo2max. Also, the pulse was monitored regularly. After each 3 minutes of the training and during 5 minutes of restitution phase a blood test was performed to assess lactic acid levels.Lactic acid levels intensity was analyzed with „D-max" methodology. This method allows assessment of the body stress, whereas the runner was close to crossing his oxygen uptake threshold. „D-max" is the most appropriate method for middle-distance runners, especially when it comes to the fast restitution phase after the training finishes. „D-max" method allows finding a connection between the highest value of the lactic acid, the lowest one and the actual lactic acid level during the training (Cherg B. , Kiperg H.).

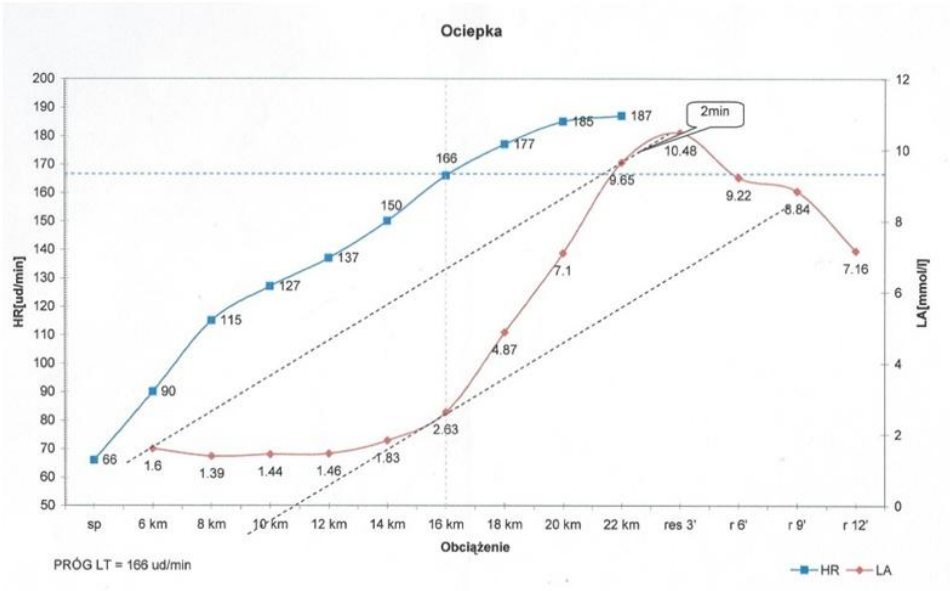


Illustration 1. D-max method. The anaerobic changes threshold indication; 166 beats per minute is the maximum threshold for the runner in question.

Both runners undertook dynamic exercise of progressively increasing workload to maximal oxygen consumption test twice. Once before, and once after the mesocycle.

3. TEST RESULTS

3.1 Anaerobic threshold changes and maximum level of oxygen uptake during the training session.

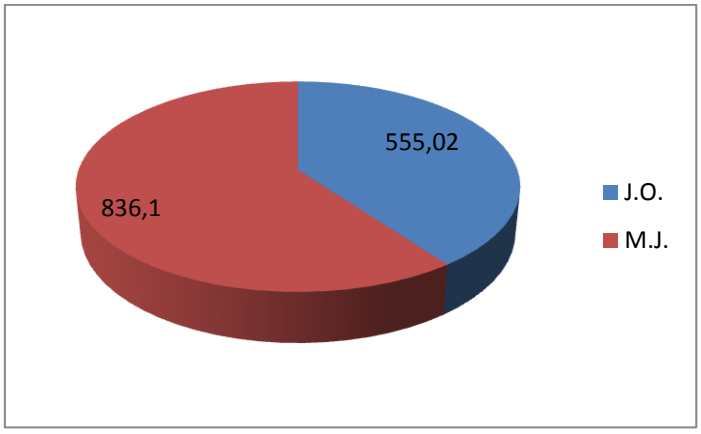
Table 3. Runner 1. Vo2max and LT changes

Runner I (J.O)	Anaerobicthreshold changes	Maximum level of oxygen uptake
26.01	166 bpm	70 mcg/kg/min
29.03	170bpm	76mcg/kg/min

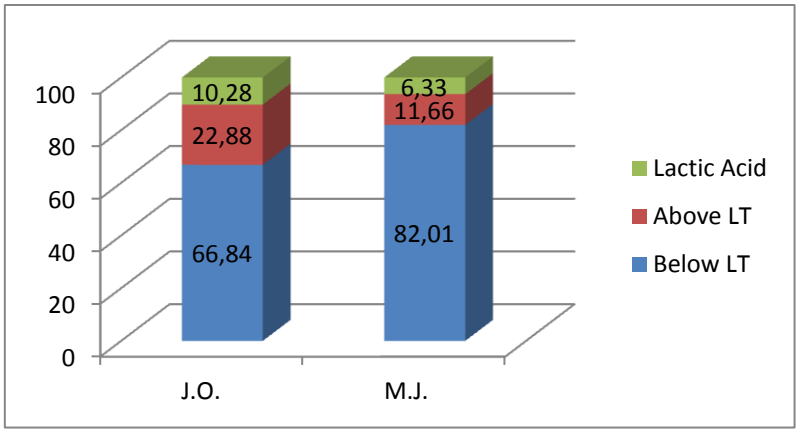
Table 4. Runner 2. Vo2max and LT changes

Runner II (M.J)	Anaerobicthreshold changes	Maximum level of oxygen uptake
26.01	170 bpm	73 mcg/kg/min
29.03	168bpm	79mcg/kg/min

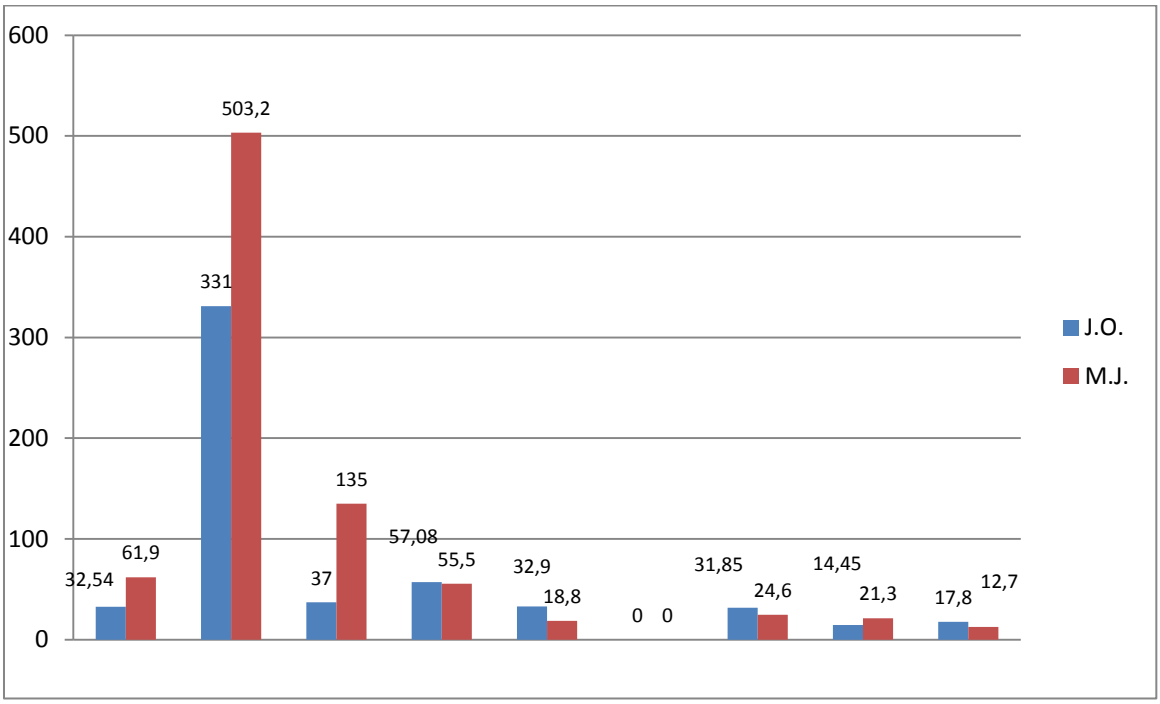
3.2 Training capacity and intensity during 9 - weeks' preparation mesocycle:



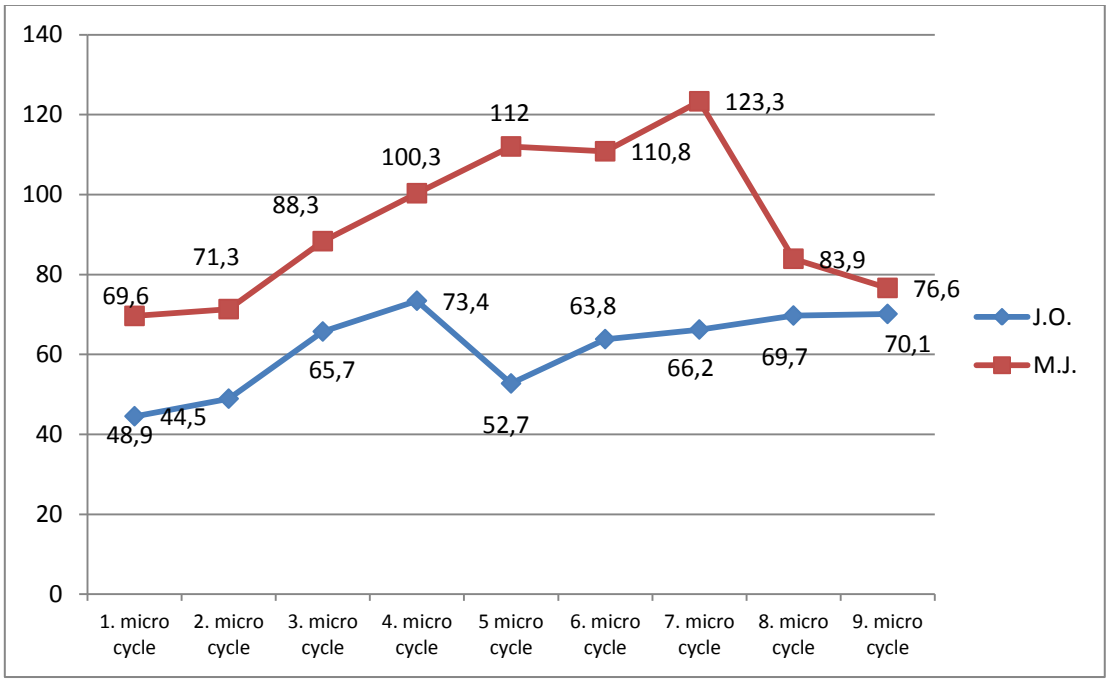
Graph 1. Mesocycle's training capacity
(in comparison with the total amount of kilometres run)



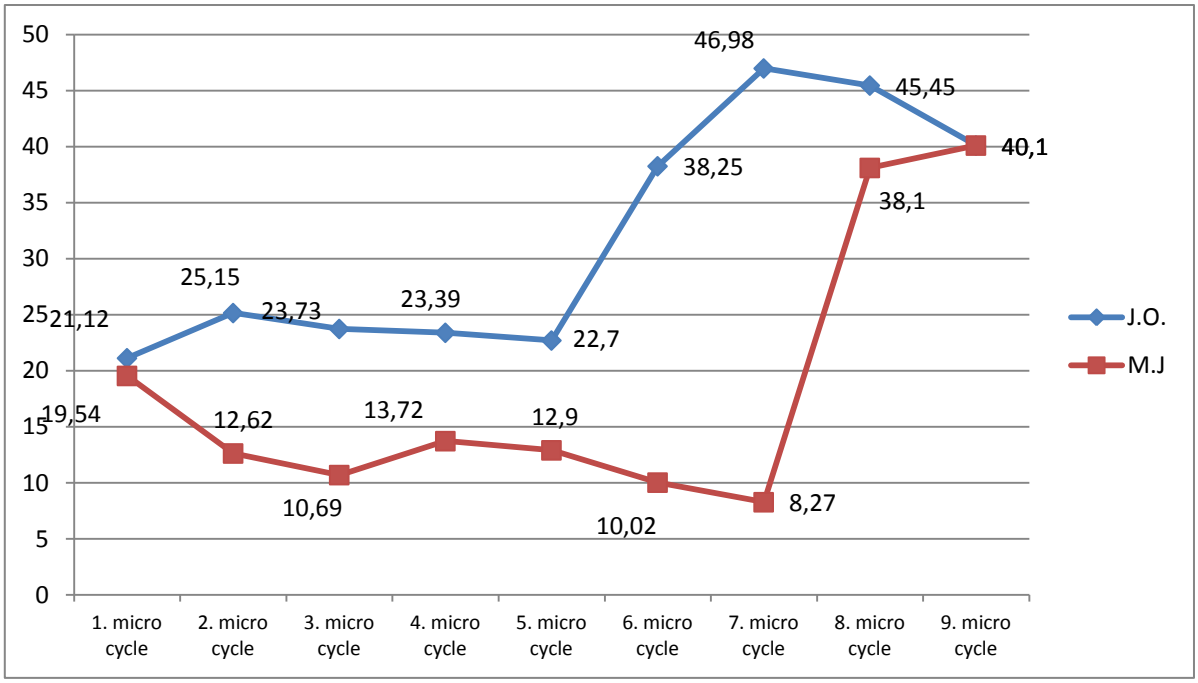
Graph 2. Mesocycle's training intensity
(energy storage zones compare with the entire training capacity)



Graph 3. Training tools contribution to the runners' mesocycle (in kilometers)
(jog OWB1 OWB 2 OWB3 WT WSz Rhytms Skip jump run)



Graph 4. Training capacity progress across particular mesocycles' microcycles (in kilometres run)



Graph 5. Training intensity progress across particular mesocycles' microcycles (in above LT and lactic acid level percentage compared with the microcycle capacity).

4. CONCLUSION AND DISCUSSION

The results of the research clearly show that the increase of anaerobic changes does not necessarily mean Vo2max decrease. The scientific publications (Rabadan, Enoksen, Maldonado – Martin) indicate an inverse relation between the influence of the training and physiological parameters of stamina. Studies show that in 9 weeks' preparation period subjects running 555,2 kilometres distance, where 33%would be above the anaerobic changes, results in an increase of both those values. Training equalling 836,1 km, whereonly 16% would be above the LT level, results in an increase of Vo2max with simultaneous decrease of LT threshold. It becomes clear that the increase of both those values during training preparation session results in a better environment for the BPS cycle (direct runners' pre-race preparation). Modern tendencies to intensify training in high energetic sports disciplines (Bompa) are being confirmed in this study's results. Still, the proportionality and variety of training tools plays a very important role. The runner in who's training we can observe increase of Vo2max and LT will definitely have a varied schedule using more complex training tools; with a major emphasis on the runner's strength (Table C).

Based on Professor Sozański's coding method, we are running a risk of misclassifying training tools used in the preparation mesocycle. Only the real and empiric knowledge of the physical parameters of the runners allows us to analyze and register the training structure reliably. This pilot study is a first step to a larger research, where the study group would be increasedand based on the 1st and higher class runners. This will result in designing an objective system of analyzing and interpreting training techniques. The basis for this will be a dynamic exercise of progressively increasing workload to maximal oxygen consumption test and the test'sparameters.

5. REFERENCES

1. Cherg B., Kiperg H. [2009] *A new approach for the determination of ventilator and lactate thresholds.*"The I-Sport" nr 13 : 518-522.
2. Gladden L.B. [2009] *Lactate metabolism during exercise* ."Principles of exercise biochemistry".
3. Klimek A. [2004] *Fizjologiczne reakcje układu oddechowego podczas wysiłków fizycznych na tle wydolności aerobowej i anaerobowej u dzieci i osób dorosłych* .Wydawnictwo AWF Kraków.
4. Mleczko E. [2000] *Współczesne koncepcje treningowe w konkurencjach wytrzymałościowych.*„Sport wyczynowy" nr 3-4 : 23-28.
5. Mroczyński Z., Fatiak M., Piątek M. [2000] *Ćwiczenia specjalne w wybranych konkurencjach lekkoatletycznych* .AWF Wrocław.
6. Prusik K. i inni [1998] *Proporcje obciążeń treningowych zrealizowanych przez juniorów młodszych – biegaczy na średnich dystansach w rocznym cyklu treningowym* .„ Kierunkioptymalizacjiobciążeńtreningowych".
7. Rabadaniinni [2011] *Physiological determinants of speciality of elite* ***middle-*** *and long-****distance*** *runners. „*Journal of Sports Sciences" nr 29 .
8. Ryguła I [2003] *Proces badawczy w naukach o sporcie.* AWF Katowice.
9. Sobczyk K. [1999] *Struktura treningowa w sportach II grupy energetycznej*.AWF Kraków.
10. Sozański H, Śledziewski D. [2000] *Obciążenia treningowe.*COS Warszawa.
11. Zatoń M. [1990] *Wartość kryteriów fizjologicznych w kontroli i regulacji treningu sportowego.*„ Studia i monografie" nr 22.