MODELS OF TRAINING RACE-WALKERS DURING THE MEZOCYCLE OF THE DIRECT PREPARATION FOR STARTS BASED ON THE MULTI-CRITERIA METHOD OF THE ANALYTIC HIERARCHY PROCESS

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Abstract

Aim. In the sports training of the best competitors around the world, there are many ways to organize the direct preparation for a start. This training stage usually determines success. Despite such awareness, there is no knowledge as to which training system model can be considered the best in preparation for the most important sports event.

Selection of the most effective variant of a champion’s sports training system in direct preparation for the Olympic Games in the 50 km race-walk.

Basic procedures. In our research, we based on the assumptions of the multi-criteria Analytic Hierarchy Process (AHP), which was developed by T.L. Saaty. The goal of the work progressed steadily: the main criteria (training measures, renewal, volume, Substantive structure training, base) were determined and subcriteria were allocated to them. A multi-level structure of the problem was built in the form of a hierarchical tree with respect to the main objective. A special interview with questionnaire was developed utilizing Saaty’s 9-level fundamental comparison scale. These interviews were conducted with 14 coaches of the best athletes in Poland and the world in the 50 km race-walk. It’s the purpose of the study was to define the main criteria and subcriteria within the structure of hierarchical dominance (preferences, weights). The article gives the priority (weight) for all criteria and subcriteria as the geometric average of all the trainers’ answers. The subsequent step in finding the best way to prepare the athletes for the 50 km race-walk was to develop training models and choose the best alternative. The computer programs Super Decisions and Expert Choice were used to perform calculations.

Results. Among the 5 established criteria, training measures were the highest ($P_{tr. meas.}=0.389$) for all experts (coaches). Analysis shows that training in the DPS is the most important criterion. The next two measures (Substantive structure training and base) were given equal priorities ($P_{mat. str.}=P_{B}=0.180$). Less important was the volume ($P_{vol.}=0.146$), and the least important – renewal ($P_{ren.}=0.104$). The sum of the priorities is always 1 (100%). The highest global priority was achieved by the PE subcriterion (19.61%). Among the 4 decision alternatives (training models), the best turned out to be the model by the younger-generation Polish coaches.

Conclusion. The AHP is an adequate tool that demonstrates the findings well, therefore it may be suitable in choosing the most appropriate training alternative in the direct preparation for a start in the 50 km race-walk.
Introduction

Developing an optimal training system for top-level sporting events is the main task of champion training in every sports discipline. The importance of organizing direct preparation for the most important start is among the many components of time structure in sports training. This is a very important issue. In spite of this awareness, according to sports theorists [1], only 34-40% of athletes reach the peak of sports condition during the target event. Improperly planned or conducted training in direct preparation for a start (DPS) can waste the work put into the entire training macrocycle or even several years of it [2]. In turn, proper preparation of Polish champions in swimming and Track-and-Field for the most important event in the world demonstrated improvement in personal bests [2].

Most often in the improvement of time structure organization, simulation in several variants (3-5) of phases is considered: reconstruction, intensification and super-compensation, occurring in subsequent 7-day training microcircuits. In addition, the impact of such variables as: sport discipline, adaptability of the athlete, regulations, terms and conditions of the competition, are also considered. Based on theoretical assumptions and practical experience, it is a very impoverished set of factors determining the effectiveness of training developed in direct preparation for a start of the best athletes in the world. It is known that starting efficiency depends on taking a number of other factors into account. In sports theory [2, 3], they are grouped into 5 basic subsystems determining success in sports, such as:

1. qualification for sport: recruitment and selection,
2. prediction: development of the sports discipline, sports results and shaping sports careers,
3. infrastructure and financial security of training (base),
4. level of knowledge of the training staff (training championship),
5. central training link: training sessions, competitions (rivalry), renewal.

In attempting to develop an optimal variant of direct preparation for the start (in DPS) of a race-walker representing the championship international class, in our study we tried to use a different methodological approach to organizing the training system. It was based on the Analytic Hierarchy Process (AHP). Its creator was Prof. Thomas L. Saaty, honorary doctor of the Jagiellonian University, eminent mathematician, economist, psychologist and politician and long-time professor at the University of Pittsburgh.

The Analytic Hierarchy Process is one of the heuristic methods border-lining on two separate domains, practically combining elements of mathematics and psychology. The main domain of this method is to present non-measurable (elusive, intangible) things in numerical terms in the form of priorities. The results of the study allow us to choose a decision which, given the criteria chosen, will be the most favourable. This method is considered among the best in the world in the context of multi-criteria decision-making. It is successfully used in countries such as the U.S.A., Indonesia, China, Japan. It is also in continuous use as support and in making important decisions by, among others, NASA, the U.S. Army, the U.S. Navy, IBM, Boeing, Shell. It is also utilized in various fields of science and social life (economics and management, economics, technology, negotiation) to study multicriterial problems [5, 6].

In Poland, T.L. Saaty’s method of AHP was widely distributed mainly by Krakow researchers [7-10]. So far, it has not found much use in solving decision problems in sports. Assessing costs, benefits and threats of organizing the large international EURO 2012 sports event in Poland was based on its assumptions [11], and in modelling the restructurization of hockey recruitment and selection system in Nowy Targ, which was considered in the past “the capital of ice hockey Poland” a long time ago [12]. Thanks to this method, important arguments for the organization of the Olympic Winter Games in Krakow-Zakopane were also gained, which unfortunately for various reasons, will not be organized in Poland or Slovakia (reueuszras.pl/relacja-z-konferencji).

The choice of method was thought out and dictated by the desire to break the belief that the sport training system is a complementary one in which all elements are of great importance. In the Analytic Hierarchy Process (AHP), the main criteria and their subtypes are distinguished by having a different contribution to explaining the phenomenon. Alike every multi-criteria and one-criterion method, the proposition of T.L. Saaty’s method also has its advantages and some limitations [6, 13]. It is characterized by simplicity, versatility, generality and flexibility. This makes it possible for those without mathematical education to use it. The methodological approach comes down to three principles: decomposition of the problem, expression of opinion by comparison and hierarchical composition (synthesis) of priorities. Research methods and standard tools are used. The use of the AHP method leads to the selection of the best model (in our case, direct preparation for starting in the Olympic Games) from different alternative versions.

Aim of own research

Selecting the most effective variant of a champion’s sports training system in direct preparation for the Olympic Games in the 50 km race-walk using the Analytic Hierarchy Process.
Research questions

1. What main and sub-criteria are currently preferred in the direct preparation for a start in the most important competitions around the world by the best coaches of champions in the 50 km race-walk?

2. Which training system model used in the direct preparation for starts in the most important competitions around the world used by trainers for the 50 km race-walk can be considered most effective in light of the results obtained using the Analytic Hierarchy method?

Material

Interviews were conducted with 14 coaches of 50 km race-walkers, representatives of the international championship class from Europe and Asia. 5 of them were from Poland, the others represented Slovakia, France, Russia, Belarus and South Korea. Each of them had substantive competence to speak about the research problem. Their opinions were used to determine priorities in the training system during the direct preparation of the athlete to start in the 50 km race-walk at the Olympic Games. The criteria for selecting trainers considered:

- at least four years of work experience with master class players,
- the race-walkers trained by them won championship titles at international competitions in the 50 km race-walk (e.g. European Championship, World Championship, participation in the team of World Cup winners).

Methods

The information was collected in accordance with the assumptions of T.L. Saaty’s Analytic Hierarchy Process (AHP) multi-criterion method [4, 14-18], taking under consideration the following methodological steps (Fig. 1):

- posing the problem and identifying the main objective,
- decomposing the problem consisting in building a problem in hierarchical form, where the overriding objective is placed at the top of the hierarchy, and the next level is occupied by criteria, then subcriteria, and at the lowest level of the structure, the so-called alternative decisions are placed,
- expressing opinions by experts via comparison – at each level of the hierarchical structure of the elements and pair-wise (“peer-to-peer”), in relation to the criteria placed higher in the hierarchy, Saaty’s fundamental scale was implemented used for comparisons,
- calculating conformity ratios (CR), i.e. the logic of verbal pair comparisons, the main criteria and partial sub-criteria,
- hierarchical composition of the problem consisting in multiplying the value of local criteria by the values of the global criteria, and then adding them to the values of the elements placed lowest. Values of the criteria – the so-called priorities, are obtained after normalizing the vector of their matrix,
- choice of alternatives (models) in order for an expert to compare them with one another using Saaty’s 9-grade scale,
- comparing the alternatives (peer-to-peer, relative to all subcriteria),
- choosing the best alternative.

Tools and techniques

The model of Analytic Hierarchy Process (Fig. 1) developed by T.L. Saaty was selected. Based on the methodological approach [14-18], the solution of the main research problem in the form of a hierarchical tree model is presented (Fig. 2). Its top-level structure comprises of: the precedent aim of the hierarchy, the next level represents criteria (sub-goals, attributes), the next subcriteria, sub-subcriteria subtypes and alternatives (Fig. 2). Alternative decisions (variants, models, scenarios) formulated the lowest level of the model. This allowed hierarchical ordering of issue importance ranging from the highest to the lowest.

At the next step of the methodical procedure, the experts had to perform comparison of the degree of importance and the preference of the elements relative to the common criterion at a higher level at each hierarchical level. In the interview with the coaches (experts) of the best Polish and international athletes in the 50 km race-walk, Saaty’s 9-grade scale of comparison was applied [4, 19].

The respondent, answering a series of questions, had to give an opinion on which of the criteria is more important in relation to the main objective, and then which of the subcriteria is more important for the criterion, and if they are more important on a scale from balanced (1) to absolute superiority (9). The evaluator noted the preferences on the comparison table in pairs: criteria, dominance (advantage) of one criterion over the other on a verbal scale ranging from equal, weak, strong, very strong to absolute. If one criterion did not dominate the other with respect to the object of comparison (case of equivalence of the two criteria in the assessment), the evaluator marked equal dominance of the criteria (no superiority of one above the other). The score was recorded on the comparative table as “balanced”. The calculated weights for each criterion proved the rank of the individual components of the 50 km race-walkers’ training system in direct preparation for a start in important sports competitions.
Methods of research result analysis

Conformity ratios (CR) were calculated, i.e. the logic of verbal pair comparisons, the main criteria and the partial subcriteria that occurred during interviews with coaches. This was done using Saaty’s 9-grade scale [4, 19]. The permissible margin of error in the opinions should not exceed 10% (CR=0.1). Its excess was not permitted, similarly as 100% consistency in comparisons (CR=0) was unfavourable.

The weights of priorities for the criteria and subcriteria were determined using the Super Decisions and Expert Choice™ computer programmes. On their basis, the global priority was calculated, which is the percentage "share" of a particular subcriterion in the posed problem (the total process of training competitors in direct preparation for a start).

Formula: $P_{jg} = P_{ik} \times P_{ij}$

where:

$P_{jg}$ – weight (priority) “global” for $j$ of this subcriterion in relation to $i$ of the main criterion,

$P_{ik}$ – weight (priority) $i$ of this criterion,

$P_{ij}$ – weight (priority) local $j$ of this criterion in relation to $i$ of this criterion.

In the final stage of searching for the best way to prepare for a start in the 50 km race-walk, alternative training models were identified and conducted using Saaty’s 9-grade scale, and the Super Decisions computer programme was used to determine the weight of alternatives in relation to the considered subcriteria. Finally, we chose the best alternative of training system for the champion’s...
Fig. 2. Diagram of Analytic Hierarchy Process model according to T.L. Saaty [19]

Fig. 3. Hierarchical tree of direct preparation for the start (DPS) of a 50 km race-walker according to Saaty’s method [4, 19]
Source: Own elaboration.
Note: the definitions of the names of criteria and subcriteria can be found in available textbooks on Track-and-Field [21] and sports theory [2].
Extra explanations: training measures used in the competitor’s training:
ORWE1,2 (overall race-walker endurance 1) – first level of intensity, to maintain previous training level, to perfect the functions of cardiovascular and respiration system. This level is in charge of removing fatigue product from the muscles. Physiologically it is the intensity below the oxygen balance.
ORWE2 (overall race-walker endurance – 2) – second level of intensity, to work in full oxygen balance, it has important impact on training level. It is one of the basic training work form of the competitor for 50 km.
PE (Pace Endurance) – third level of intensity, it is similar to special endurance. In practice there is the possibility to work in the continual, repeated or variable form with the intensity exceeding the oxygen balance, so the effort is not fully compensated with oxygen.
Strength – training muscle strength in race walking.
Overall efficiency – exercises of all basic muscle groups.
sport training system in the direct preparation for the Olympic Games in the 50 km race-walk.

Research results

The Fig. 3 show a description of the hierarchical tree model of direct preparation for the 50 km race-runner, which was created according to Saaty’s method [4], following consultation with trainers (experts), athletes, sports managers, club directors, sports theorists (experts in various disciplines). The main objective, which was to create the optimal training model in direct preparation (DPS) of the champion for the 50 km race-walk in the most important competitions (the Olympics, the World Championships), was placed at the peak. The next level consisted of 5 main criteria: training measures, renewal, volume, substantive structure training and base. 4-5 subcriteria for each of them were added at lower levels. Decision possibilities were placed at the lowest level, which include 4 alternative training models.

Determination of criteria importance in relation to main aim of research

As it can be concluded from the following table (Fig. 4), according to the experts’ opinions expressed via T.L. Saaty’s 9-grade scale, the highest priority in the mesocycle for the direct preparation of athletes performing 50 km race-walking (values given in percentages) in relation to the main objective which was developing the best training concept for starting in the most important sports event, was granted to training measures (P=38.9%). The other main criteria were: (i) substantive structure training and base (P=18%) > volume (14.6%) > renewal (P=10.4%) were given lower weights (value).

| Training measures | 0.388989 |
| Renewal | 0.104492 |
| Volume | 0.146511 |
| Substantive structure training | 0.180004 |
| Base | 0.180004 |

Fig. 4. Values of main criteria regarding the direct preparation of a 50 km race-walker for a start

Determining the importance of local priorities of subcriteria on Saaty’s scale relative to particular main criteria

Table 1 lists the juxtaposition of local subcriteria weights (priorities) in relation to the main criteria that were included in the 50 km race-walker training model. The following is an abridged summary of their characteristics (values are given in percentages).

Criterion – training measures

On the basis of the data presented in the table above, it was assumed that in determining the fitness of a walker during the direct preparation for a start in the 50 km race-walk, the experts gave the highest priority within the main training component to training measures, the subcriterion pace-endurance (PE) was given (P=50.6%). Lower weight was given to: ORWE (P=29.7%), while the remaining components of the training structure in direct preparation for starts were considered too insignificant for achieving success in major competitions: overall efficiency (P=8.2%) > strength (P=7.6%) > running (3.6%).

Criterion – biological renewal

Within the framework of the main criterion of biological renewal, the experts drew attention to the following subcriterion: nutrition (P=54.0%). The remaining subcriteria achieved lower weight; physical therapy (P=18.8%) > supplementation (P=14.6%) > pharmacology (P=12.3%).

Criterion – training volume

Of the subcriteria included in the training volume main criterion, which should be carried out in the week of direct preparation prior to the start, the experts gave the highest priority to the volume of 150-200 km/week (P=43.95%) and its range of 100-150 km/week (P=38.33%). Little recognition was given to high and low training load volumes of 200 km/week (P=11.32%) and up to 100 km/week (P=6.3%).

Criterion – training Substantive structure training

In the Substantive structure training main criterion of training, the experts emphasized the importance of the overall efficiency subcriterion (P=59.77%). To our surprise, the subcriterion of technical preparation (P=19.47%) was given relatively low priority and the remaining elements of the training structure were of low importance in the preparation for a start: mental preparation (P=12.8%) and tactical preparation (P=7.8%).

Criterion – training base

As it can be seen from the data on the significance of subcriteria within the base main criterion, the experts were particularly divided in expressing their opinions on priority distribution. Training personalization (P=37.87%) obtained a slight advantage while the other subcriteria were similar with regard to given weight values: financial resources (P=24.3%) > training monitoring (P=19.6%) > place of training (P=18.1%). Attention is drawn to the
lack of interest regarding high-altitude training in the direct preparation phase (a subcriteria of place of training). Only some Polish and Slovakian coaches have emphasized the importance of training in specific climatic conditions to succeed in major sports competitions.

**Determining the reliability and logic of verbal pair comparisons**

In order to determine the logic and reliability of the verbal pair comparisons, the CR coefficients for main criteria and partial subcriteria were calculated [4, 19]. The 10% margin of error was not exceeded in any of the cases. The value of the compliance ratio was calculated using the Super Decisions* computer programme. The obtained results authorized further analysis of the collected material.

**Calculation of global priorities**

In Tab. 1, the values of subcriteria of local and global priorities in relation to the main criteria are presented. As it is known, global priorities mean the individual impact of each subcriterion on the main goal: the effectiveness of training in direct preparation for starting in the most important 50 km race-walk championship event.

On the basis of the analysis of their weights, large variation among the weights (priorities) of all subcriteria can be noticed. Of all the subcriteria considered, 3 exceeded 10% of the desired individual impact on the main goal: PE (P=19.6%) > ORWE (P=1.5%) > overall efficiency (P=10.8%). Significant subcriteria are also: nutrition (P=8.9%), 150-200 km/week (P=6.0%), training personalization (P=4.9%) and technical preparation (P=3.5%).

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<th>Criteria</th>
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<th>Local priorities</th>
<th>Global priorities</th>
</tr>
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<td></td>
<td>PE</td>
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<td></td>
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<tr>
<td>Volume 0.138228</td>
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Source: Own elaboration.
Seeking the best alternative sports training model for 50 km race-walkers in the direct preparatory period for starts in the most important sports event

The next stage of research was the development of alternative models of 50 km race-walker training in direct preparation for the most important sport event. Their creations are based on the results of previous research using the two highest weights given by the experts in the main criteria. It was assumed that their sum in local priorities should explain more than 50% of validity with respect to the main criteria. Table 2 also lists the global importance of these priorities. They provided a benchmark for expertly distinguishing 4 alternative training models and identifying their distinctive features.

1. **Polish model M-1** – represented by older-generation trainers with vast training experience. They can be counted among the creators of the “Polish school of race-walk training”.

2. **Polish model M-2** – comprised of a group of younger Polish trainers, including distinguished race-walkers. Among them was an Olympic champion and a group of experienced Polish coaches, recruited mainly from former race-walkers.

3. **Euro-Asian model M-3** – comprised of foreign coaches from Europe and Asia.

4. **French model M-4** – due to the criteria applied, only one French coach who was a World Championship medal trainer and a two-time European Champion in the 50 km race-walk were included.

Following analysis of the material aimed at bringing the considered subcriteria down to parallel numbers, the models were compared with each other using T.L. Saaty’s 9-grade scale. The obtained results were analyzed using the Super Decision computer programme. The calculated weights of alternatives regarding 21 subcriteria are presented in Tab. 3.

### Description of weights relative to subcriteria – result of “peer-to-peer” models

**ORWE**<sub>1,2</sub>

Regarding the subcriterion of overall race-walk endurance – **ORWE**<sub>1,2</sub>, the best (62.5%) training alternative was the Euro-Asian model (M-3) (S.W., St.M.). Apart from the Polish model (M-1) of the older generation of trainers (K.K., I.M., B.B., M.S., L.L.), for whom the weight of the

<table>
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Models of training race-walkers during the mezocycle…

alternative relative to the subcriterion was set at 24%, it was relatively low in the remaining cases: M-2 (8.1%) and M-3 (5.3%).

**PE**
In the case of developing the race-walkers’ endurance – PE, the highest rank of alternatives (56.9%) was found in the M-2 Polish model of trainers from the younger generation (R.K., W.M., G.S., S M.). Apart from the M-3 model (2.6%), in other cases the share of alternatives relative to the subcriterion was more significant: M-4 (26.7%) and M-1 (11.3%).

**Running**
A very unusual form of movement for developing the walking technique, i.e. running, gained a relatively high weight of alternatives relative to the subcriterion: M-1 (36.7%). M-2 (30.7%) and M-3 (24.2%), with the exception of the French model M-4 (8.1%).

**Strength**
The highest weight (49.5%) in alternatives relative to the subcriterion of strength development was found in the French model (M-4). Their lower priority was found in models: M-2 (19.9%) > M-3 (16.4%) > M-1 (14%).

**Overall efficiency**
Similarly, as in the case of race-walker strength training, in the French model, the highest priority of the alternative relative to the subcriterion regarded overall efficiency (M-4) (39.5%), which was comparable to the Polish model of the older-generation M-1 coaches (35.5%). The lowest weight of the alternative was obtained by the model of Polish younger-generation coaches: M-2 (8.8%), and slightly higher weight was noted in the case of the Euro-Asian (16.1%) M-3 model.

**Nutrition**
The value of the alternatives’ priority relative to the subcriterion of nutrition showed that only the model of Polish senior trainers had the highest rank of alternatives (62.0%). The subsequent position was occupied by the French model (21.2%). Very low weight of alternatives was found in the model of Polish M-2 younger-generation coaches (6.7%) and in the Euro-Asian M-3 model (9.9%).
Supplementation
In the case of the significant subcriterion, i.e. the use of supplementation in the training of athletes (supplementation), it must be stated that the highest alternative was found in the M-2 model of young Polish coaches (67.2%), while the lowest was found in the French M-4 model (6.6%). The alternatives of the two following models slightly exceeded the value of 10%: M-1 (13.0%) and M-3 (10.6%).

Physical therapy
In reference to the subcriterion regarding the use of physical therapy by race-walkers, the best alternative (62.5%) was found in the French M-4 model (60.7%). The Polish M-2 training model (26.4%) was also of great importance. The M-1 Polish model (7.6%) and the Euro-Asian M-3 model (4.9%) were of the least priority.

Pharmacology
In the alternative relative to the pharmacology subcriterion, the highest weight was observed in the Euro-Asian M-3 model (71.3%). In the remaining models, the weights of alternatives were lower in the Polish models: 14.3% for M-1, 8.7% for M-2, and the French model: 5.5% for M-4.

Training volume up to 100 km/week
Evaluating the weight of alternatives in 4 training models with respect to the subcriterion, where the application of a low training volume up to 100 km/week was assumed, it turned out that there was an advantage of alternatives in the case of 2 models: M-2 (32.6%) and M-3 (36.2%); for the remaining models: Polish older-generation coaches: M-1 (16.3%) and the French model: M-4 (14.7%).

Training volume of 100-150 km/week
Considering the weight of alternatives relative to criterion: training volume of 100-150 km/week, it turned out that there was a very clear advantage only in the French model: M-4 (59.0%). While there were very similar alternative weights in the Polish models: M-1 (18.4%) and M-2 (18%), the weak alternative appeared in the Euro-Asian model: M-3 (4.0%).

Training volume above 200 km/week
In the case of alternatives relative to the subcriterion of very high-volume training sessions, above 200 km/week, it turned out that their high value was revealed in the M-4 French model (50.3%) and the Polish M-1 model (31.8%). Similar weights of the alternatives in the Polish M-2 (8.8%) and in and Euro-Asian M-3 (8.9%) models were low.

Overall efficiency
The highest weight of alternatives relative to the subcriterion of overall efficiency, the name of which encom-
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is very diverse in the 4 alternative training models. Surprisingly, they were the highest in the Polish model of older-generation M-1 coaches (66.8%). Other models had low values: M-3 – 16.9%, M-2 – 9.6% and M-4 – 6.2%.

As a result of the above, there were clear differences in the creation of models for the preparation of an athlete for the most important 50 km race-walk event.

Selection of the best alternative training model

In order to select the best alternative training model from among those considered, we further analyzed the weight of the alternatives relative to subtypes in the 4 training models using Saaty’s 9-grade scale. Raw calculations were analyzed using the Super Decision computer programme. The final results of selecting the best model are given in Tab. 4. In addition, the indicators for their normalization were calculated. The reference point was regarded as the highest priority value given to the model that reached the highest raw score (0.276). On the basis of data analysis, the model of younger-generation Polish coaches: the M-2 model, should be recognized as the best alternative training model in relation to the main objective of developing the most effective training programme in direct preparation for starting in the most important 50 km race-walk competition. The following places were occupied by the Euro-Asian M-3 model > the Polish older-generation of trainers M-1 model > the French M-4 model, with only slight differences. The best alternative model was based on the coach training concept created by those who were outstanding athletes in the past. The multiple-time Olympic champion R.K. and European vice-champion G.S. could be found among them.

However, it should be noted that the differences between the models were small. They were within the range of 5% (min 0.226-max 0.276). In addition, it should be emphasized that in all models, the impact of the training concept on the training effect in direct preparation for a competitor’s start in the most important event did not exceed 30%.

**Summary and discussion**

The presented results do not have a reference point to similar ones documented in domestic or foreign literature. Although Prof. T.L. Saaty’s Analytic Hierarchy Process (AHP) model has been known for a long time and is successfully implemented in various areas of social life [5, 7-12, 18-20], in this publication, it is applied for the first time in order to develop an effective model of sport training for professionally competing athletes.

According to the methodological approach of the Analytic Hierarchy Process, it was agreed after discussion with the experts that the aim of research would be to try to create an effective concept of preparation for a start in the most important sports event of a 50 km race-walker, i.e. the Olympic Games or the World Championship. Thanks to information from 14 domestic and foreign coaches of the best 50 km race-walkers around the world and other experts in the organization of the training process in a very interesting athletic competition, the main and subcriteria allowing to fulfill the purpose of research and alternatives were identified.

With the use of AHP methodology and computer programmes, numerical values of local and global priorities were obtained in relation to the main criteria. Analysis of the values of the main criteria shows that our research has found their varied effect on the objective of study i.e. on the effectiveness of training in the direct preparation for a start in the most important 50 km race-walk event. The highest weight (in percentages) may be attributed to the selection of training measures (P=38.9%). Less weight was obtained by other criteria: Substantive structure training and base (P=18%) > volume (P=14.6%) > renewal (P=10.4%). This phenomenon has also been confirmed by the analysis of the value of global priority subcriteria. Only 3 of them exceeded 10% of the desired individual impact on training in the direct preparation for the start: PE (P=19.6%) > ORWE (P=11.5%) > overall efficiency (P=10.8%).

On the basis of the obtained results, it can be assumed that 14 trainers (experts) presented their own views on training solutions during the period of direct preparation

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**Tab. 4. Selection of best training model in the DPS for the 50 km race-walk**

<table>
<thead>
<tr>
<th>Model (training alternatives)</th>
<th>Graphical presentation of priorities</th>
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Fig. 5. Weight comparison (%) of alternative training models (M-1, M-2, M-3, M-4) relative to subcriteria.
for the most important event of the best race-walkers in the world. We may not rule out that this evidenced by the necessity to adapt the training system to the adaptive abilities of a particular athlete. It is also possible to see the confirmation of the already well-established regularity that trainability of an athlete is an individual and not population-based feature [22]. The stated phenomenon could also perhaps be the consequence of averaging the results of the opinions of 14 coaches (experts).

High expectations were associated with the creation of alternative training models and the results of their “peer-to-peer” comparison relative to the adopted subcriteria. However, it turned out that similarly as in the model created by 14 trainers, there is a large variety of approaches to solve the problem of effective preparation of a champion race-walker. This may be confirmed by the graphic illustration of the weight of 21 subcriteria in 4 training models (Fig. 5).

Despite the possibility of performing taxonomies of the models according to the value of alternatives with the aid of the Super Decision computer programme, and demonstrating that the model by the Polish younger-generation coaches is the most appropriate (Tab. 4), attention should be drawn to the small (5%) range of differences in alternative weights between models: min 0.226 – max 0.276. This leads to the perception that it would be tempting to develop new, more effective training concepts for future 50 km race-walking champions.

Conclusions

The results of our research, conducted using T.L. Saaty’s AHP multi-criteria hierarchy decision-making process, based on the strong foundations of cognitive psychology and mathematics, indicate the possibility of using this method to develop a concept of training in race-walking during the direct preparation for starts at competitions at the highest level.

In an applicative sense, it resulted that applied methods of training used by Polish and foreign trainers are not indisputable and can be implemented in the practice of preparing a champion for competitions at the highest rank.

Among the 4 alternative models considered: older generation of Polish trainers (M-1), younger generation of Polish coaches (M-2), Euro-Asian (M-3) and French (M-4) (M-2), the M-2 model comprised of younger generation Polish coaches resulted to be the best, however, the differences in alternative weights between models were minor.

Both the value of global priorities and the weight of alternatives relative to the subcriteria in the 4 training models allow to state that there is relatively small impact of the so-far implemented training systems of the world’s best race-walkers on their success during the most important competitions.

There is a need to develop new, more effective training concepts for future 50 km race-walk champions.

References


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