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ANALYSIS OF THE PEAK PERFORMANCE AGE IN ATHLETICS (TRACK AND FIELD PART)

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ABSTRACT

The aim of this paper is to process and evaluate the peak performance age in athletics. The knowledge in this field of study plays an important role by long term planning in sport training theory. The object of this paper is analyzing the top world's championships (World Championship, European Championship and the Olympic Games) between years 1970 and 2007. Our study is based on status description using all three advisable methods (normative investigation, developmental survey and case study). During the data collecting procedure we have used both, the cross-sectional and longitudinal survey. Within our investigation we tried to answer questions concerned with significant features of the peak performance age, possibility to state the age accurately, and to monitor its progress. The needed information has been gathered from the official internet sites from each sport federation (national and international). The missing personal information was gathered from the championships, the International Olympic Committee, and personal site of each athlete. To trace back the older information we used the traditional resources. Our data set includes 6,314 athletes in total (3,474 men, 2,840 women). Some of the events have binomial distribution which enables the accurate peak performance age identification. The peak performance age has slowly increased in sprint events, and slowly decreased in long distance runs. At present, the age for both sexes moves around 25 and 26 years (except the marathon race). In addition, in long distance races is found a big disproportion between European and World Championships. In 10 km long race is the difference of 4 years in average age! We believe that our results may be of benefit to the individual sport federations, trainers and athletes themselves in their long-term planning of their sport preparation.

Key words: Athletics, Track and Field, Peak Performance Age, Development, European Championship, World Championship, Olympic Game

INTRODUCTION

The aim of this paper is to process and evaluate the peak performance age in athletics. Athletics is an exclusive collection of sporting events that involve competitive running,

jumping, throwing, and walking. The most common types of athletics competitions are track and field, road running, cross country running, and race walking. In our paper, we are dealing only with the part of track and field disciplines which take part in our monitored international competitions.

The knowledge in this field of study plays an important role by long term planning in sport training theory. This work will help the trainers to estimate when it is roughly necessary to start with the specialized training, so that the athletes would attain the peak performance at the optimum age. In the Czech Republic the authors writing about the age of peak performance are in particular Měkota, Kovář, Štěpnička (1988), Dovalil et al. (2002) and Turek, Ružbarský (2001). There were more authors abroad but their conclusions are mostly specified in general terms. They are for example Bompa (1990), Martin et al. (1999), Weineck (1987), Fixx (1985), Espenschade, Eckert (1980), and others. It stands to reason that most of the authors concentrate on the ages in individual sports such as athletics, swimming and gymnastics.

Měkota, Kovář and Štěpnička (1988) analyze the ages of top athletes in the 1976 Olympic Games in Montreal. Their graph is noticeable for its separation the athletes' age and the competition distances. Very important were their claims such as: "For nowadays sport is typically a particular rejuvenation. Remarkable is the large interval between the youngest and the oldest competitor in the individual sport events" (Měkota, Kovář, Štěpnička, 1988, 95).

Dovalil et al. (2002) states that the age of winners in the Olympic Games had not changed in the last 60 years (except in swimming and gymnastics, where it decreased by 2–3 years). Further he mentions a table with the age of peak performance and the age for starting the peak performance.

Martin et al. (1999) studied an individual growth of athletes' performance – long jumpers and high jumpers – the finalists at the 1992 Olympic Games in Barcelona.

The next author is Weineck (1987). He separates the age of peak performance into three successive periods. He calls the first one the period of the first success. The second period is called the period of optimal performance. He calls the third one the period of stabilization of high performance. In his papers he closely concentrates on athletics.

Fixx (1985) published a longitudinal study of the best performances in marathon races during the 20th century.

Espenschade and Eckert (1980) show the ages of peak performance in two tables. In the first one, the data was collected from sports where skills play the major role, for example golf, shooting and billiard. The average age was around 30 years of age. The second table was dedicated to the age distribution at the 1968 Olympic Games in Mexico.

Baur et al. (1994) contextualizes very interesting graphs of the evolution of the athletes running speeds at different distances. We can say that except for marathon race, there were no significant changes in the peak performance ages at any distance.

The last forenamed author – Bompa (1990) takes a new view on this theme. "However, youngsters' high efficiency in athletics seems to be based on the fact that what really counts in athletics is not chronological but rather biological age" (Bompa, 1990, 34). Further he points towards the physical necessity of maturation before starting specialized training of endurance.

Table 1. The peak performance age in athletics by Weineck (1987), Dovalil et al. (2002), Espenschade and Eckert (1980), and Bompa (1990).

Event	Weineck (1987)		Dovalil et al. (2002)	Espenschade and Eckert (1980)		Bompa (1990)
	Men	Women	Men	Men	Women	
100 m	22–24	20–22	21–23	24.3	20.8	
200 m	22–24	20–22	21–23	24.3	20.8	
400 m	24–26	22–24	21–23	24.3	20.8	
800 m	25–26	22–25	24–26	24.3	20.8	
1500 m	25–27		24–26	24.3	20.8	
5000 m	26–28		24–26	24.3	20.8	
10 000 m	26–28		24–26	24.3	20.8	
Marathon	27–30					
High jump	22–24	19–22	22–24			
Pole vault	25–28		22–24			
Long jump	23–25	20–22	22–24			
Triple jump	24–27		22–24			
Shot put	24–25	21–23	25–27	25.2		
Discus	25–26	22–24	25–27	25.2		
Javelin	26–27	23–24	25–27	25.2		
Hammer	26–30		25–27	25.2		
Decathlon (Pentha)	25–26	23–25				
Athletics						18–23

PURPOSE

Based on the above mentioned studies, the peak performance age is to a great extent unresearched topic. There are just partial papers which were hardly ever coherently published. The authors usually took their data sets just from one competition (mostly the Olympic Games). The total review in the sport science is still missing. That is why we decided to follow our research. The object of this paper is analyzing the top world's championships (World Championship, European Championship and the Olympic Games) between years 1970 and 2007.

AIM OF STUDY

The main aim of this study is to determine the peak performance ages in individual athletic disciplines. Their knowledge is one of the important factors during setting the long-term training plans in the sport training.

To accomplish that, it is necessary to set partial goals. These goals can be divided into three basic areas. The first is the search for information sources which contains not only athletes' performance information but also information about their ages or birth dates. The next area is the criterion definition for the peak performance age determination in individual sports. The last area is the collection and evaluation of the acquired data according to the predetermined procedure.

In terms of time, the aim of this study is defined by the period between years 1970 and 2007.

In terms of location, we have focused on European and global data. Specifically, they were the results from the Olympic Games, World Championships and European Championships.

While monitoring the peak performance age, we dealt with the following scientific questions at every individual sport discipline:

- What are the general significant features for the peak performance age determination?
- If the exact peak performance age is possible to determine in the given disciplines?
- What is this age in individual disciplines?

PROCEDURES

Our study is based on status description using all three advisable methods (normative investigation, developmental survey and case study). During the data collecting procedure we have used both, the cross-sectional and longitudinal survey. Within our investigation we tried to answer questions concerned with significant features of the peak performance age, possibility to state the age accurately, and to monitor its progress.

"Descriptive research is a study of status and is widely used in education and the behavioral sciences. Its value is based on the premise that problems can be solved and practices improved through objective and thorough observation, analysis, and description" (Thomas, Nelson, 1996, 314).

Blahuš (1996) describes research dealing with studying of new relations as research with an explorative target. But it is also necessary here to choose suitable statistical instruments, mostly according to the type of variables.

Kovář and Blahuš (1989) and Vincent (1995) describe the process by setting the frequency tables and the frequency diagrams. With their help, it is possible to judge the type of distribution visually. While studying our collected data we found altogether three types of distribution which corresponded to all individual sports. It was the Gaussian distribution, left sided Gaussian distribution and binomial distribution, which exclude the accurate identification of the peak performance ages.

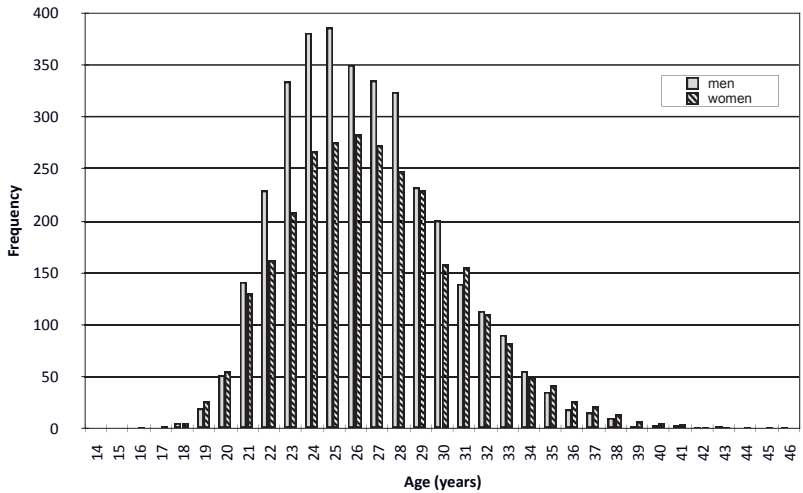
Into our set, we took the first three athletes from each sport event. The specific information has been gathered from the official internet sites from each sport federation (national and international). The missing parts of personal information were gathered from the championships, the International Olympic Committee, and personal site of each athlete. To trace back the older information we used the traditional resources. **Our data set includes 6,314 athletes in total (3,474 men, 2,840 women).**

Statistical procedures:

1) Size of the set (n), number of athletes included in our study.
2) Minimum (min), the lowest value of the set.
3) Maximum (max), the highest value of the set.
4) Average (AVG).
5) Standard deviation (SD).
6) Mode (modus), the most frequent value
7) Histogram (frequency diagram), from minimum to maximum for each year.
8) Moving average with period equaled to 2.

RESULTS

From the historical point of view the development in athletics is very interesting not only from the performance viewpoint but also from the athletes' age development viewpoint. Amongst the major advantages of these studies belong the virtually unchangeable disciplines and rules of most of the athletic disciplines and that athletics belongs between the most studied sports. This later on significantly eases the tracing of the necessary data because the amount of citation resources is relatively large. Below we present total data about the age in World Championships and European Championships both indoors and outdoors and also the data from all the Olympic Games since the year 1970. All summary data are for a better clarity presented also in the graphical form and the summary table.



Graph 1. Age of the first three athletes of all athletic events in World Championship, European Championship, and the Olympic Games (1970–2007).

Table 2. Basic statistical data from set of medalists from World Championship, European Championship, and the Olympic Games (1970–2007).

	men	women
n	3,474	2,840
Minimum (years)	17.27	15.42
Maximum (years)	45.25	44.74
Average (years)	25.96	26.37
Standard deviation (years)	3.68	4.02

The graph and the table show that the optimum age in athletics is around 25 years of age for men and around 26 for women. It is evident that we deal with slightly left sided Gaussian distribution. To compare the age of men and women is not very purposeful here, because there are naturally listed more athletic disciplines for men than for women and therefore the total frequency of occurrence is higher for them. Moreover, from the shapes of both curves, there is obvious that the peak performance age for both sexes is almost similar. In total, we evaluated 3,474 records of the athletes' ages for men and 2,840 for women. The youngest medalist in this period of time was Javier Sotomayor, who won the silver medal in the high jump in indoor World Championship in 1985 in Paris, while the oldest athlete was Ivan Ivancic, the bronze medalist in the shot put in indoor European Championship in 1983 in Budapest. The youngest among women enrolled medalist Sally Barsosio, who – in her 15 years of age – won the bronze medal in the 10,000 metres run in World Championship in 1993 in Stuttgart. The oldest medalist was Yekaterina Podkopayeva, who won in the 1,500 metres run in indoor World Championship in 1997 in Paris.

Now we will describe individual athletic disciplines. First of all, we will concentrate on the running, after that on hurdle races and walking disciplines and in the end we will focus on the technical disciplines.

1) Flat running

Table 3. Total view on the peak performance age in running disciplines for men.

	60 m	100 m	200 m	400 m	800 m	1500 m	3 km	5 km	10 km	mar.
n	124	90	172	214	213	213	123	90	90	90
Minimum (years)	18.52	18.87	17.31	18.28	18.88	20.44	19.77	18.49	19.49	22.38
Maximum (years)	33.06	34.35	32.28	33.03	35.38	35.13	34.36	36.21	37.49	40.25
Average (years)	**24.9**	**25.4**	**24.6**	**24.5**	**24.6**	**25.4**	**26.2**	**26.1**	**26.3**	**2.4**
Standard deviation (years)	3.0	3.1	3.1	2.8	3.0	2.9	2.9	3.9	3.9	4.0

Table 4. Total view on the peak performance age in running disciplines for women.

	60 m	100 m	200 m	400 m	800 m	1500 m	3 km	5 km	10 km	mar.
n	123	90	172	213	211	210	126	39	63	72
Minimum (years)	18.71	17.98	18.57	17.33	19.01	18.41	18.74	18.25	15.42	21.77
Maximum (years)	37.29	40.39	37.25	37.01	37.01	44.74	38.56	36.41	32.78	38.52
Average (years)	**24.6**	**26.0**	**26.0**	**25.8**	**26.5**	**27.3**	**27.0**	**25.7**	**26.3**	**29.5**
Standard deviation (years)	3.5	3.8	3.9	3.4	3.9	4.7	4.2	4.0	3.9	3.8

It is obvious from the tables, that the ages are almost similar for men and women in all running disciplines except from the marathon run. Although in all other disciplines there is a slight increase in the average age together with increasing running distance, the difference between the medalists' arithmetic mean in the 100 m run and in the 10 km run is only 0.88 years for men and 0.33 years for women. So we must evidently consider the previous assumptions and researches and analyze all this problemacy more thoroughly.

Another interesting phenomenon while comparing bisexual differences is the apparent cohesion of male sets. For women, the standard deviations are always slightly higher (about one year) than for men, which we partly justify by relatively lower competitive fight within female category and partly by the higher occurrence of older athletes when comparing with the male set. This phenomenon of higher successfulness of older competitors occurs virtually in all runs from 60 m till 3,000 m. It would be interesting to have a closer look on details of these competitors and to find there some common factors influencing this feature. For example, whether it applies also for the women who returned to competition after their maternity leave and so on.

For the long-distance running distances from 5,000 m and more, the set no longer acts as the normal distribution and therefore we took for the peak performance age the continuous age interval which included all athletes from 10 till 90 percentile. It is evidently due to the significant disproportion between worldwide competitions (arithmetic means: World Championship = 24.4 years and the Olympic Games = 25.8 years) and European competitions (European Championship = 28.7 years). That can be caused by the attendance of runners from African tableland in World Championships and the Olympic Games. Those, which is generally well-known, reach their peak efficiency much earlier than European runners. As examples could be given two the most widely known runners: Haile Gebrselassie who won its first top race in 1993 in Stuttgart in his 20 years of age and Kenenisa Bekele who won in 2003 in Paris in his 21 years of age.

2) Hurdle race, steeplechase and walking race

Table 5. Total view on the peak performance age in hurdle race, steeplechase and walking for men.

Men	60 m hurdles	110 m hurdles	400 m hurdles	3 km steeple	20 km walk	50 km walk
n	123	90	90	90	90	87
Minimum (years)	17.93	20.13	18.91	19.07	18.95	20.63
Maximum (years)	35.04	35.47	33.69	33.62	38.25	42.09
Average (years)	**25.0**	**26.1**	**26.1**	**25.9**	**27.9**	**29.9**
Standard deviation (years)	3.7	3.5	3.4	3.4	4.3	4.0

Table 6. Total view on the peak performance age in hurdle race, steeplechase and walking for women.

Women	60 m hurdles	110 m hurdles	400 m hurdles	3 km steeple	20 km walk	50 km walk	60 m hurdles
n	125	91	75	9	33	33	27
Minimum (years)	18.47	20.95	20.20	23.35	18.24	16.84	19.99
Maximum (years)	37.30	35.35	36.83	29.46	33.70	31.58	38.23
Average (years)	**26.0**	**27.0**	**26.9**	**25.9**	**25.6**	**26.0**	**29.4**
Standard deviation (years)	3.6	3.4	3.8	2.3	4.2	3.7	5.2

From tables, there is an evident congruence of the medalists' average age in all hurdle races between 25 and 27 years of age. So not even here are evident any tendencies of change in the average age depending on the length of the race. Comparing hurdle races with flat runs we can pronounce that we deal with slightly older (roughly about one year) and less coherent sets (higher standard deviation). In women, older athletes very often return back to the peak performance again.

In walking disciplines, the average age and standard deviation are significantly higher. For both men and women competitors' ages do not play the major role in walking sport. It is possible only to assume an explicit continuous interval of ages in which racers reach the peak efficiency.

3) Technical disciplines

From the overall view we can see that in the first four disciplines, i.e. jumps, there is an obvious dominance of speed-power requirements. These requirements also limit the peak performance age and basically correspond with the short and medium running distances. Athletes' average age moves round 25 years of age here. Both sets are very coherent in this direction and the standard deviation moves around 3 years.

Table 7. Total view on the peak performance age in technical disciplines for men.

Men	high jump	pole vault	long jump	triple jump	shot put	discus	hammer	javelin	decath.
n	224	217	213	213	213	90	90	90	135
Minimum (years)	17.27	18.99	19.04	17.71	20.76	22.52	19.50	20.15	20.09
Maximum (years)	32.95	33.94	35.47	36.25	45.25	40.19	37.72	40.23	34.93
Average (years)	**24.2**	**25.6**	**25.1**	**25.8**	**27.2**	**29.7**	**28.2**	**27.4**	**26.8**
Standard deviation (years)	3.0	3.2	3.4	3.5	3.6	4.3	3.7	3.8	3.0

Table 8. Total view on the peak performance age in technical disciplines for women.

Women	high jump	pole vault	long jump	triple jump	shot put	discus	hammer	javelin	heptath.
n	216	67	194	93	213	90	30	90	135
Minimum (years)	16.34	18.06	18.22	19.10	17.62	20.22	17.90	18.26	19.08
Maximum (years)	34.13	32.95	36.44	33.86	40.21	40.73	34.86	35.30	37.14
Average (years)	**25.0**	**24.0**	**25.8**	**26.6**	**2.4**	**28.7**	**25.1**	**26.5**	**26.3**
Standard deviation (years)	3.6	2.9	3.6	3.0	4.3	4.8	4.3	3.8	3.6

In the next group, there are technical-strength disciplines (shot put, discus, hammer and javelin), which are characteristic by higher athletes' average age and by wider range of their peak performance age. The average age in these disciplines moves around 27 and 29 years of age and standard deviation often exceeds four years abnormalities. The only exception is the female hammer discipline, which was listed as a discipline between top competitions in the year 1998 and evidently only younger generation athletes enroll into this discipline. It stands to reason, that in these technical-strength disciplines, sets will always show the wider range of the peak performance age.

Whole sets in decathlon and heptathlon are specific to the significant coherency (the smallest range of variation and small standard deviation). These sets represent the normal distribution characteristics and the average age moves round 26 years of age.

DISCUCION

The first scientific question we asked in our study was as follows: What are the general significant features for the peak performance age determination? Here we can declare that it is possible to use more ways for the peak performance age determination in athletics. In the individual sports where the competitors' places are defined on the basis of exact measurements under the standard outer conditions, it is possible to determine the peak performance age set by the help of:

1. Athletes' ages distribution to a certain order. It is possible to use several different levels for all participants, finalists in the events, medalists or only the determination of winner's age.
2. The number of competitors' successes in the monitored periods of time (numbers of medals, places in World cups, ranking positions, etc.).
3. The times attained by one competitor in individual years (casuistic approach).
4. The best world's times either in individual years or globally (actual age during the individual maximum annual achievement, or actual age during the achievement of world record).

The second question was focused on the possibilities of the peak performance age determination in the given sport sector. There are obvious reasons based on our results, which lead most of the experts to the wider point of view on the peak performance age as a specific time interval. Most of graphs show that the distribution function has the Gaussian distribution. In these cases, it is possible to determine the exact peak performance age which is though necessary to understand as a certain interval (at least the mean ± the standard deviation). However, if the distribution was asymmetric (mostly left sided), then we determined the exact peak performance age as a mode of our set. The determination of the peak performance age interval, however, is already more problematic issue. The third type of distribution that we encountered in our study was the binomial distribution. In this distribution, we are not able to record even the exact peak performance age and to state the arithmetic mean or mode of our set does not make sense. The behavior of a distribution function practically enables to make any extrapolation leading to more accurate peak performance age determination. In this type of distribution we recommend to take as a relevant only the whole continuous interval of the peak performance age. This interval was determined by expert assessment in order to include 80% of all successful athletes. We began with the maximum value and then, gradually widened the interval of continuous area of values until we reached the limit of 80% of all studied probands. We are aware that setting such a boundary is only approximate but, while constructing it for individual sport sectors, it showed to be optimal.

The third scientific question we asked in the beginning of our study referred to the peak performance ages in individual disciplines. For better clarity we present these ages in the following table.

Table 9. The peak performance age in athletics on the basis of analysis of results from the Olympic Games, World Championships and European Championships between the years 1970–2007. The value of the peak performance age is showed in bold. It is the mean in the case of Gaussian distribution, mode in the case of asymmetric distribution. Disciplines in red show the binomial distribution and the mean or mode can not be considered as valid variables for the peak performance determination.

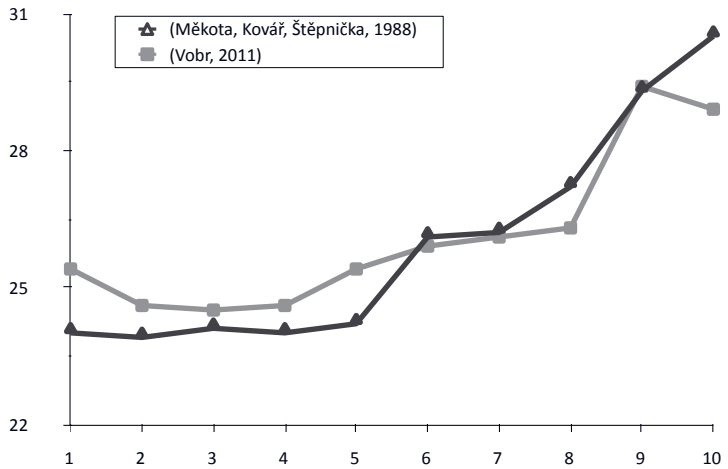
Discipline	Mean (mode)		80% percentil interval	
	Men	Women	Men	Women
60 m run	**24.86**	**24.64**	21–28	20–29
100 m run	25.37	**25.95**	22–29	22–29
200 m run	**24.60**	**25.95**	21–28	21–29
400 m run	**24.54**	**25.75**	21–29	23–31
800 m run	**24.61**	**26.51**	21–27	21–31
1500 m run	25.36	**27.34**	22–30	21–33
3000 m run	26.15 (**24**)	27.04 (**25**)	23–31	21–31
5000 m run	**26.05 (24)^{x}**	**25.70 (24)^{x}**	**21–31**	**21–31**
10 000 m run	**26.25 (24,5)^{x}**	**26.28 (29)^{x}**	**21–31**	**21–33**
Marathon	**29.41 (32)^{x}**	**29.46 (30)^{x}**	**25–35**	**26–36**
60 m hurdles	25.01 (**23**)	**26.04**	21–32	22–29
110/100 m hurdles	**26.12**	27.01 (**26**)	21–29	23–31
400 m hurdles	**26.13**	26.92 (**28**)	21–31	23–32
3000 m hurdles	**25.88 (28)^{x}**	**–**	**21–31**	**–**
20 km walking	27.85		23–35	
50 km walking	29.89		25–35	
High jump	**24.20**	24.98 (**26,5**)	20–30	20–30
Pole vault	25.64	**24.04**	22–30	22–26
Long jump	**25.10**	25.76 (**27**)	21–30	21–31
Triple jump	25.79 (**24**)	26.58 (**28**)	22–29	24–30
shot put	27.19 (**25**)	27.37 (**25**)	23–33	23–32
Discus	**29.68**	28.73 (**27**)	25–38	25–35
Hammer	28.24 (**29**)	25.10 (**24**)	23–32	22–25
Javelin	27.38 (**30**)	**26.54**	22–31	22–32
Multi-event compet.	**26.78**	**26.32**	22–32	22–31

CONCLUSIONS

To determine the peak performance age, we can generally use two basic approaches. The first of them is intro-individual **casuistic approach** describing the gradual increase of athlete's performance on the basis of his/her best annual performances. We use this approach

mostly for individual and objectively measured sports such as athletics or swimming. The second approach uses the **age distribution of athletes** in top national or international competitions. This approach has much more general application and that is why it is also used by most authors dealing with this problemacy. It is for example Bompa (1990), Espenschade and Eckert (1980), Dovalil et al. (2002), Měkota, Kovář, Štěpnička (1988) and Weineck (1987).

The main aim of this study was **the peak performance age determination in individual athletic disciplines**. From the time point of view, this study was limited by the period of time between years 1970 and 2007. From the location point of view, we focused on European and global data. Specifically, they were the results from the Olympic Games, World Championships and European Championships. There is no similar study known to the authors dealing with this problemacy in such a time extent. Most of authors studied only partial results from one top competition. It is for example the study of Měkota, Kovář and Štěpnička (1988), who analyzed the athletes' ages in the 1976 Olympic Games in Montreal. In the end we would like to include a comparison of our results in some disciplines with the results of these authors. From the graphical representation is apparent the significant similarity of our results and also the current trend of slight increase in the peak performance age, especially on shorter races and a decrease of the peak performance age in pedestrian disciplines.



Graph 2. Comparison of our results with the study of Měkota, Kovář and Štěpnička (1988, 97), who analyzed the peak performance age of participants in the summer Olympic Games in Montreal (1976).

While comparing male and female results we can notice significant bisexual differences. Male sets **are always more coherent** than female sets. We can partly explain that by the relatively **lower competition in female categories. In addition, in running athletic disciplines we can observe the phenomenon of higher success of older competitors**, which occurs practically in all races from 60 m to 3,000 m.

Sets of long-distance runners are not coherent neither. It is probably due to the very considerable disproportion between world and European competitions. For example, in the

10 km race the arithmetic mean is 24.4 years in World Championships, 25.8 years in the Olympic Games and 28.7 years in European Championships. This disproportion can be caused by the **attendance of runners from African tableland in World Championships and the Olympic Games**. They obviously reach their peak performance age much earlier than European runners. As examples could be given two the most widely known runners: Haile Gebrselassie who won its first top race in 1993 in Stuttgart in his 20 years of age and Kenenisa Bekele who won in 2003 in Paris in his 21 years of age.

The accuracy of the peak performance age determination on the basis of the distribution curve **depends on the type of the distribution**. The most frequent was the normal distribution. Apart from that, we encountered also the binomial distribution, asymmetric left sided distribution and recently in the ice-hockey also the two-peak distribution.

In the sport sector, where the age distribution has the features of the binomial distribution, **there is not possible to determine exact peak performance age**. They are mostly endurance sports with high demands on technical commands of the given sport. In such cases, it is not possible to determine neither global nor local maximum of the age distribution function and it is only possible to determine the age interval which includes most of the top world athletes. In our study, we set this **age interval between 10 and 90 percentile** of the studied set.

We believe that among the greatest benefits of our study is the effort for the comprehensive approach to the given problemacy and the considerable size of the sample. The total size of our sample in athletics made **6,314 athletes, of whom 3,474 of men and 2,840 women**. During the collecting of our data we used the methodology ensuring us a very high success of tracing the necessary information (we managed to trace the birth dates in more than 99% of athletes).

On the contrary, amongst the biggest difficulties of our work belonged the **time-consuming data collection, technical problems** during sorting and processing them and the **variety of information resources** (it was very often necessary to use gradually all available resources and the method of triangulation from multiple sources).

We gathered these information mostly from the official internet sites from each sport federation (national and international), official sites of individual championships, the International Committee sites and also from personal sites of each athlete. To trace back the older information we used the traditional literary resources referring to the individual events.

The result is this presented study which brings the innovation of some previous knowledge from this area. We believe that our results may be of benefit to the individual sport federations, trainers and athletes themselves in their long-term planning of their sport preparation.

It is also obvious to the authors that in respect to the limited length of this study, it was not possible to describe the peak performance age in all points of view. For example, it would be suitable to compare changes of the peak performance age in connection with the socially-political changes in Europe, e.g. before and after the year 1989 or to compare the interval of the peak performance age in individual decades of the studied period of time. On the initiative of some of these viewpoints, authors can take an inspiration for possible future studies.

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ANALÝZA VĚKU VRCHOLNÉ VÝKONNOSTI V ATLETICE

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SOUHRN

Předložená studie se zabývá problematikou věku vrcholné výkonnosti v atletice. Z hlediska územního se jedná o výsledky z olympijských her, mistrovství světa a mistrovství Evropy z let 1970 až 2007. Práce je ve své podstatě deskriptivní studií, vycházející ze tří základních postupů (normativní šetření, vývojový výzkum a případová studie). V rámci výzkumu jsme se snažili odpovědět na otázky týkající se stanovení signifikantních ukazatelů věku vrcholné výkonnosti, možnostmi jeho přesného stanovení a vývojem věku vrcholné výkonnosti. Potřebná data byla získávána z oficiálních internetových stránek mezinárodní atletické federace, oficiálních stránek jednotlivých mistrovství, stránek mezinárodního olympijského výboru a osobních stránek jednotlivých sportovců. Starší data pak byla zjištěna z tradičních tištěných pramenů. Sledovaný soubor obsahuje data narození 6314 atletů (3474 mužů a 2840 žen). Na základě našich výsledků musíme vyvrátit dříve obecně platné tvrzení, že průměrný věk závodníků roste s délkou tratě. Z výsledků běžeckých disciplín je zřejmé, že u mužů i žen je téměř shodný věk u všech běžeckých disciplín kromě maratónského běhu. Soubory atletů vytrvalců navíc nejsou koherentní. To je zřejmě dáno velmi výraznou disproporcí mezi soutěžemi celosvětovými a soutěžemi evropskými. Například v běhu na 10 km je rozdíl mezi aritmetickými průměry na MS a ME 4 roky. Doufáme, že naše výsledky pomohou při dlouhodobém plánování sportovní přípravy jak trenérům, tak i jednotlivým sportovcům.

Klíčová slova: atletika, věk vrcholné výkonnosti, vývoj, mistrovství Evropy, mistrovství světa, olympijské hry

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