

# ANALYSIS OF PEAK PERFORMANCE AGE IN ATHLETICS

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## INTRODUCTION

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. This work would help the coaches to estimate when it is roughly necessary to start with the specialized training so that the sportsman would attain the peak performance at the optimum age. In the Czech republic above all Měkota, Kovář, Štěpnička (1988), Dovalil et al (2002) and Turek, Ružbarský (2001) devote to the peak performance age. 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 and Eckert (1980) and others. It stands to reason, that the most of the authors attend to the study age in individual sports, such as athletics, swimming and gymnastics.

Měkota, Kovář a Štěpnička (1988) analyze the age of top athletes at the Olympic games in Montreal in 1976. Noticeable is their graph where they set aside the age of athletes and the competition distance. Very important were their claims: "For nowadays sport is typically a particular rejuvenation. Remarkable is a large interval between the youngest and the oldest competitors in the individual sport event (Měkota, Kovář, Štěpnička, 1988, 95).

Dovalil mentions et al (2002), that the age of winners at the Olympic Games didn't change the last 60 years (except in swimming and gymnastics, where it decreased by 2-3 years). Further he mentions a tablet with the peak performance age and the age for starting the peak performance.

Martin studies et al an individual growth of performance at the athletes – long jumpers and high jumpers – the finalists at the Olympics Games in Barcelona in 1992.

The next author is Weineck (1987). He separates the peak performance age into the 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 the high performance. In his papers he dwells on athletics closely.

Fixx (1985) published a longitudinal study of historical best performance in marathon race during the 20<sup>th</sup> century.

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

Baur et al (1994) contextualizes very interesting graphs of the evolution of the athletes running speed at different distances. We can say that except for marathon distance didn't change significantly the age of peak performance at any distance.

The last forenamed author – Bompa (1990) takes some 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 at physical necessity of maturation before starting specialized training of endurance.

*Tab. 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	
1 500 m	25-27		24-26	24,3	20,8	
5 000 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 data of preface, the peak performance age is to a great extent unsearched. There are just partial papers, which are hardly ever consistent published. The authors took the data sets just from one competition (mostly the Olympics games). The total review is still missing in the sport science. That is why we decided to follow our research. The object of this paper is analyzing the top world's championships since (World Championship, European Championship, and Olympic Games) during 1970 – 2007.

While monitoring the peak performance age we will at the individual sports events envisage the following scientific questions:

- 1) What are the common marking factors for the assessment of peak performance age?
- 2) It is possible in a given sports event to specify peak performance age?
- 3) What is the peak performance age in relevant sports event?
- 4) How are general trends of peak performance age in the last years?

## PROCEDURES

Our study based on status description, using all three advisable methods (normative survey, developmental survey and case study). By data collection both have been used, cross-sectional and longitudinal survey. Within our investigation we try to answer the questions concerning the significant marks of peak performance age, the possibility to state the age accurately, and 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 the research dealt with the study of new relations as research, which has an explorative target. But here also is necessary to choose suitable statistical instruments according above all to type of variables.

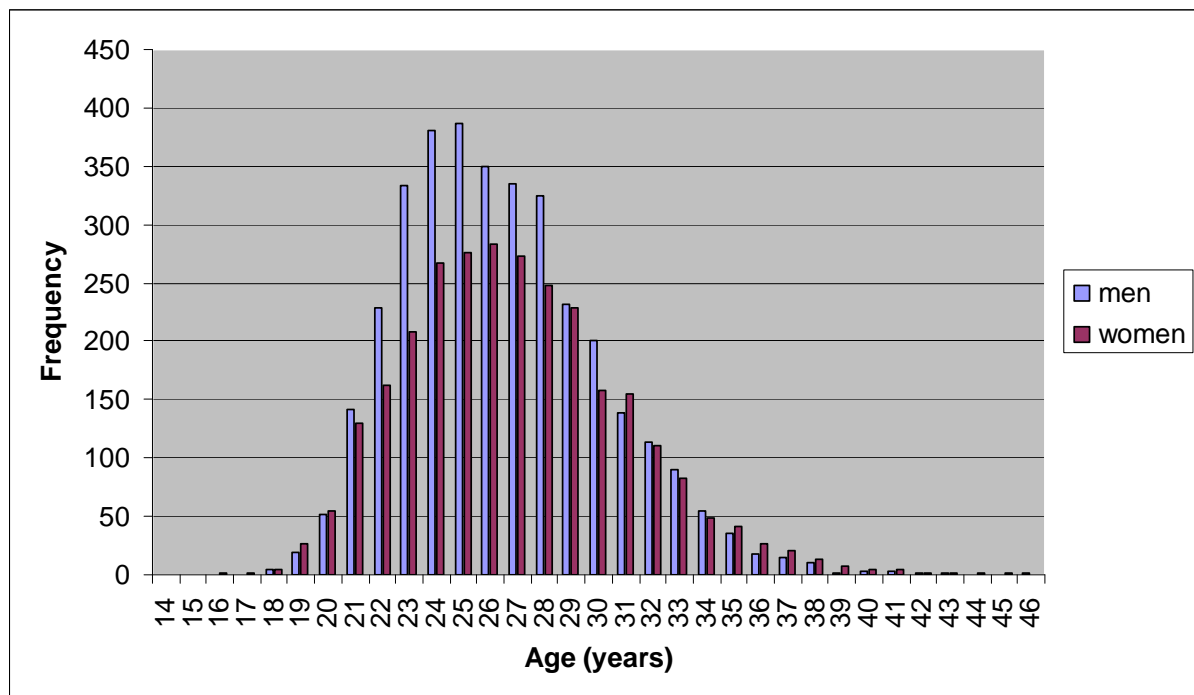
Kovář and Blahuš (1989) and Vincent (1995) describe the process by setting frequency tables and frequency diagram. With its aid it is possible to visually judge the type of distribution. We bargain for typical Gauss distribution, left sided distribution, and binomial distribution which exclude the accurate peak performance age identification.

We into our set take the first three sportsmen from each sport event. The needed information has been gathered from the official internet site of each sport federation (national and international), championships, International Olympic Committee, and personal sites of each sportsman, sportswoman. To discover an older peace of information we used the traditional sources. Our set has 6314 athletes (3474 men, 2840 women).

## RESULTS

From historical viewpoint the evolution in athletics namely as from the sight of performance, so from the sight of competitors' age is very interesting. Among the main initiatives hereof studies belongs to that the in principle main athletic disciplines and their rules are practically fixed as well as that the athletics belong to ones from most observed sports in general. This notably salving needed data search, because citation sources are relatively in a big quantity. The sources we're exploiting partly by obtaining results from the individual championships and partly by obtaining information about the age or more precisely athlete's date of birth are shown in chapter literature.

And now we'll already follow with ascertained facts. First we take away general data about age from World and European championships namely as in the hall, thus in the open air and also the data of all Olympic games since 1970. All records are shown in the summary form hereinafter graph and table.



Graph 1 Age of first three sportsmen of all athletic events at World championship, European Championship, and Olympic games (1970 – 2007).

*Table 1 Basic statistical data from set of medalists from World championship, European Championship, and Olympic games (1970-2007)*

	men	women
n	3474	2840
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

From the graph and table it stands to reason that the optimum age in athletics moves round 25 years for men and 26 years for women. The curves have gently left sided Gauss distribution. To compare the age in both genders is not in principle efficient, because naturally in men are in athletics offered more events that is why incidence frequencies are all around higher. In addition both curves have its peak performance age approximately the same. In men competitions quite 3477 records of athletes' age were evaluated, in women competitions then 2480 records. The youngest medalist in this period was Javier Sotomayor, who won the silver medal in high jump at indoor World championship in 1985 in Paris, on the contrary the oldest athlete was Ivan Ivancic, the bronze medalist in shot put at indoor European championship in the year 1983 in Budapest. In women competitions among the youngest medalist written down was Sally Barsosio, who was in 15 years old the bronze medalist in 10 km run at World championship in Stuttgart in the year 1993. The oldest medalist was Yekaterina Podkopayeva, who won 1500 meter run at indoor World championship in the year 1997 in Paris.

And now we'll present the results of separate athletic event. First we will aim at track events and after it at technical events. Most graphs have Gauss distribution function. In these cases it is possible to determine the accurate peak performance age, that's however necessary to read as the explicit interval (at least the average  $\pm$  standard deviation). If however the distribution was asymmetrical (most often left sided), then we can set up the accurate peak performance age as a modus of a given set. The specification of the interval of peak performance age is already much more problematic matter. The third type of distribution that we've noted in our study is binomial distribution. There we're not able to write down the accurate peak performance age and to mention the arithmetical average or the modus of given set hasn't any sense. This distribution function practically make impossible to implement any extrapolation leading to the more accurately determination peak performance age. This distribution type we've signed in our result and recommend to take like relevant only the whole interval of peak performance age.

It is obvious from the tablet that above all the long tracks as at the men, so at the women, are in consideration of the destination of the age of peak performance very problematic. It is obviously given by the different age constitution of the medal holders from the European and World championships. For example in 10 km run is the average age in the European championship 28,70 years, in the World championship only 24,40 years. Some events have the binomial distribution which excludes the accurate peak performance age identification.

Table 2 Peak performance age in athletics events (<sup>x</sup> binomial distribution – mean or modus are not the relevant markers)

Event	Average (modus)		Interval	
	Men	Women	Men	Women
60 m	24,86 ± 2,95	24,64 ± 3,46	21-28	20-29
100 m	25,37 ± 3,07	25,95 ± 3,82	22-29	22-29
200 m	24,60 ± 3,12	25,95 ± 3,88	21-28	21-29
400 m	24,54 ± 2,79	25,75 ± 3,44	21-29	23-31
800 m	24,61 ± 2,99	26,51 ± 3,88	21-27	21-31
1500 m	25,36 ± 2,86	27,34 ± 4,69	22-30	21-33
3 km	26,15 ± 2,91 (24)	27,04 ± 4,24 (25)	23-31	21-31
5 km	26,05 ± 3,88 (24) <sup>x</sup>	25,70 ± 3,99 (24) <sup>x</sup>	21-31	21-31
10 km	26,25 ± 3,91 (24,5) <sup>x</sup>	26,28 ± 3,90 (29) <sup>x</sup>	21-31	21-33
Marathon	29,41 ± 3,98 (32) <sup>x</sup>	29,46 ± 3,82 (30) <sup>x</sup>	25-35	26-36
Hurdles 60 m	25,01 ± 3,74 (23)	26,04 ± 3,61	21-32	22-29
Hurdles 110/100 m	26,12 ± 3,53	27,01 ± 3,40 (26)	21-29	23-31
Hurdles 400 m	26,13 ± 3,37	26,92 ± 3,77 (28)	21-31	23-32
Steeple 3000 m	25,88 ± 3,39 (28) <sup>x</sup>	-	21-31	-
20 km walk	27,85 ± 4,34	-	23-35	-
50 km walk	29,89 ± 4,04	-	25-35	-
High jump	24,20 ± 3,02	24,98 ± 3,64 (26,5)	20-30	20-30
Pole vault	25,64 ± 3,18	24,04 ± 2,90	22-30	22-26
Long jump	25,10 ± 3,41	25,76 ± 3,58 (27)	21-30	21-31
Triple jump	25,79 ± 3,46 (24)	26,58 ± 3,01 (28)	22-29	24-30
Shot put	27,19 ± 3,56 (25)	27,37 ± 4,33 (25)	23-33	23-32
Discuss	29,68 ± 4,30	28,73 ± 4,76 (27)	25-38	25-35
Hammer	28,24 ± 3,69 (29)	25,10 ± 4,28 (24)	23-32	22-25
Javelin	27,38 ± 3,80 (30)	26,54 ± 3,81	22-31	22-32
Decathlon (Petha)	26,78 ± 3,04	26,32 ± 3,59	22-32	22-31

## DISCUCION

The first we dealt in our study with was: What are factors for assessment of the peak performance age? Here we can declare that in the athletics it is possible to use more ways for the assessment of peak performance age. At the individual sports, where the competitor's placed is defined on the basis of exact measurement under the standard outer conditions, it is possible to set the peak performance age set by the help of:

1. Competitors' age distribution to certain order. It is possible to use the several different levels of all participants, finalist given to the event, medalists or only the determination of winner's age.
2. The number of competitors' successes in the monitored seasons (numbers of medals, place in world's cup, rankings position, etc.).
3. The times attained by one competitor in single years (casuistic approach).
4. The best world's times either in individual years, or globally (actual age at individual maximum yearly achievement, or actual age at the achievement world's record).

The second question concerned the possibilities of the assessment of peak performance age in a given sports event. From our results are noticeable reasons that lead most specialists to wider sight at the peak performance age, to a certain chronological interval. Upon analyzing ascertained data, we determined nearby of all sport events the interval of peak performance age. This interval was defined by experts' appreciation so, to get in roughly 80 % of all

athletes. We started with maximum value and after it we're step by step extend interval for continuous value area, until we're fail to reach limits 80 % of all tracked units under the test. We are aware that those limits are only orientation; however at her construction for separate sport events showed are these limits optimal.

The third scientific question, which we laid at the beginning of our study, concerned the peak performance age in the appropriate sport events. By virtue of above presented results we can declare that the step by step attended significant changes in age distribution at the peak world's championships. The age of competitors at sprint increases and at long tracks lowers. Therefore our results are different from the earlier published studies and it is necessary to bring this trend into the sport scientific theory. Thereby it simultaneously remains also to answer the last fourth questions dealt with the development of peak performance age.

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## SUMMARY

The aim of this paper was process and evaluates peak performance age in the athletics. The knowledge from this area plays an important role at long term planning in sport training theory. The object of this paper is analyzing the top world's championships since (World Championships, European Championships, and Olympic Games) from 1970 to 2007. Our study is based on status description, and uses all three advisable methods (normative survey, developmental survey and case study). At data collection both cross-sectional and longitudinal survey have been used. Within our investigation we try to answer the questions concerning significant marks of peak performance age, the possibility to state the age accurately, and its progress. The needed information has been gathered from the official internet site of each sport federation (national and international), championships, International Olympic Committee, and personal sites of each sportsman, sportswomen. To discover older information we used traditional sources. Our set has 6314 athletes (3474 men, 2840 women). Some of the events have binomial distribution which excludes the accurate peak performance age identification. The peak performance age has slowly increased in sprint events, and

slowly decreased in long distances. At present the age moves in both rounds 25 - 26 years (except marathon race). In addition in long distance race is found a big disproportion between European and World championships. At 10 km track is the difference of 4 years in average! We assume that our findings will be helpful to the sport federations, coaches as well as to sportsmen with their long term planning.