VÝVOJ VÍCEBOJAŘSKÝCH VÝKONŮ V ČESKÉ REPUBLICE V LETECH 1955–2019

DEVELOPMENT OF DECATHLON PERFORMANCE IN THE CZECH REPUBLIC BETWEEN 1955 AND 2019

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Abstract

The present study examines the development of performance in the men's decathlon from 1955 to the present (2019). Using a time-series analysis, we explored the historical development of performance in the men's decathlon in the Czech Republic. The set under study included the top 10 decathlon performances in each year. Yearbooks of the Czech Association of Athletics (ČAS) and the Czech National Sports Council (ČSTV) were used as data sources. The performances were evaluated according to the internationally recognized scoring tables for decathlon events. For comparison, all performances from 1955 were recalculated on the basis of the latest internationally valid tables. After World War II, there has been a continuous improvement in performance. The performance curve of the average of the first top ten competitors had an increasing trend until approximately the year 2002, with a certain stagnation between 1975 and 1990. After that year, there has been a decline in performance and subsequent stagnation of performance up to the present. We consider the most prominent variables in the development of this performance curves to be the athletes whose scores noticeably exceed those of other competitors (Změlík, Dvořák, Šebrle). Currently, the average performance level of the top ten decathletes is found at low values corresponding to the period between 1965 to 1970. The question remains about the future development of this discipline.

Keywords: athletics; athletic decathlon; development of performance; history

Souhrn

Tato studie se zabývá vývojem výkonnosti v desetiboji mužů od roku 1955 po současnost (2019). Prostřednictvím analýzy časových řad jsme zjišťovali, průběh historického vývoje výkonnosti v desetiboji u mužů v ČR. Do zkoumaného souboru jsme zařadili vždy 10 nejlepších výkonů v desetiboji v jednotlivých letech. Zdrojem dat jsou ročenky ČAS a ČSTV. Výkony byly hodnoceny podle mezinárodně uznávaných bodovacích tabulek pro víceboje. Pro porovnání byly podle posledních mezinárodně platných tabulek přepočítány všechny výkony od roku 1955. Po 2. světové válce dochází k neustálému zlepšování výkonnosti. Rostoucí tendenci má křivka výkonu průměru prvních deseti závodníků zhruba do roku 2002 s určitou stagnací mezi lety 1975 až 1990. Po tomto roce dochází k poklesu výkonnosti a následné stagnaci výkonů až do současnosti. Za nejvýraznější proměnlivé faktory vývoje této křivky výkonnosti považujeme atlety, jejichž bodové hodnocení znatelně převyšuje bodové hodnocení ostatních závodníků (Změlík, Dvořák, Šebrle). V současnosti je průměrná výkonnostní úroveň prvních deseti desetibojařů na nízkých hodnotách odpovídajících období 1965 až 1970. Otázkou zůstává další budoucí vývoj této disciplíny.

Klíčová slova: atletika; atletický desetiboj; vývoj výkonnosti; historie

Introduction

The men's decathlon consists of ten disciplines. Thus, an athlete must be versatile to complete a race that lasts two days. The today's high level of decathlon has been brought about mainly by

the high-quality technical level in the individual disciplines. Performances require a very high level of concentration and mental resilience. Decathletes must be prepared for gradually increasing tiredness, which might cause, among other things, fear of failure (Dale, 2000). Accordingly, preparation for all disciplines is important not only in technical terms but also from the fitness, mental, organisation and social aspects. Decathlon events are the only athletic disciplines where performance is expressed in points (Ryba, 2002).

Therefore, a scoring table is prepared to reflect the individual performances, or scores can be calculated on the basis of formulas. The advantage of the current scoring system resides in the fact that it can be easily converted into a computer and a system that transforms performance into scores (Vindušková, 1984). The development of performance in decathlon is dependent on a number of factors, which, in particular, include the following:

- social conditions (professionalization and commercialization of sports, changes in the position of women in society, etc.)
- expansion of the competition programme at the national and international levels
- material and technical conditions (artificial surface of tracks and approaches, landing pits, vaulting poles, sportswear and footwear)
- development of training
- changes in scoring (Vindušková, 2007)

Decathlon cannot be treated as a sum of ten independent disciplines and must be understood as a single demanding discipline that comprises ten parts. It is therefore important to accomplish "special decathlon endurance", characterized by the smallest possible difference between the sum of points earned in decathlon and the sum of points for the highest individual performance in the individual disciplines (Vančura, 1974).

The evaluation of decathlon has undergone a plethora of changes. Since 1911, decathlon was evaluated using ten types of scoring tables. Apart from their advantages, those six types of tables contained a number of errors and various misleading statements, adjusted over the course of time. From 1955, tables were changed in the years 1950-52, 1962 and 1985. First and foremost, the tables function as a guarantee that a decathlete's performance will be justly scored with regard to his capabilities and subject to his body proportions. The current tables are very progressive in the evaluation of the long jump and hurdles. Relatively the fewest scores are gained for the javelin throw and shot put (Trkal, 2002). The development of performance in the individual athletic disciplines has been influenced by many factors, among which the most important are changes of the athletic rules, the development and use of materials and technological advancement, new progressive training methods, permitted and prohibited performance-enhancing substances and the level of "anti-doping" controls, etc. Currently, despite the "stabilization" of these factors, there has been a steady increase in performance and record breaking (Broďani, 2013).

Knowledge of the development of the individual athletic disciplines leads to further development of knowledge thanks to certain representative indicators of various human abilities and their interrelations. Thus, the question is whether the performance in the individual disciplines (representing certain human abilities) is close to the limits of his abilities and where further development will likely be directed. Forecasts of the development of performance by means of analyses and modelling of development may determine certain assumed trends (Kovář, 2008).

Decathlon disciplines can be divided into several groups, which most often are the following: sprint and jump, throwing and endurance (Broďáni, Kováčová, & Czaková, 2020). The precondition for peak performance in decathlon consists in technical and motor prerequisites, mainly of the speed and strength nature, and also coordination and endurance (Ryba, 2002). The objective of decathletes' training is to develop motor abilities and improve the technique in the individual disciplines (Vindušková & Koukal, 2003). The development of performance in the individual athletic disciplines is affected by a number of factors. First, the growth in performance is generally fast, then gradually slows down as the limit performance is saturated. The issue of limit performance is fundamental in the time-series analysis and prediction of performance (Karp, 2006; Semerád & Bahenský, 2015; Bahenský, 2017; Tilinger, 2004).

From the historical perspective, the 1950's saw sports become not only a part of social life but also a tool of political propaganda. For this reason, the government paid great attention to the centralized training of athletes (Slavik & Osoba, 2016). The best conditions were offered primarily in clubs of the Army sports system. These clubs were providers of the best conditions for national representatives, including athletes. The system of the state sports support reached its peak in the mid-1970's, when top sports centres were introduced in 1974, followed by youth training centres in 1984 and other forms of sports centres (Ptáčníkova, 2003; Jirka et al., 1997). Youth training centres (TSM) and a part of top sports centres (SVS) were abolished in 1991. The Czech Athletic Federation reintroduced youth centres in 1995 under the banner CTM (Talented Youth Centres), which were replaced by SCM (Sports Youth Centres) founded by the Ministry of Education, Youth and Sports in 1998. In the performance development of individual athletes, the level of talent, the adaptation of the training load to the athlete's individual dispositions and biological age play a great role (Bahenský, 2019; Bahenský & Tlustý, 2020). The development of performance after World War II was affected also by changes in training methods. The training methods used have gradually improved, and training has become more and more individualized (Bahenský & Grosicki, 2021).

In the Czech Republic, decathlon is a highly successful sports discipline, with such competitors as Robert Změlík, Tomáš Dvořák, and Roman Šebrle achieving excellent success in world competitions. Together with these athletes, a generation of coaches grew up who took care of the performance growth of these competitors, e.g. Robert Černý, Rudolf Černý, Boleslav Patera, Jiří Ryba, Zdeněk Váňa, Luděk Svoboda, Josef Karas and others (Ryba, 2002; Karta atleta, 2021).

Since the end of World War II, athletic disciplines have undergone in the Czech Republic a development that will show certain common features. The objective of this study is to analyse the performance of decathletes in the Czech Republic from 1955 to 2019.

Methodology

This study is concerned with the development of performances in the men's decathlon from 1955 to the present. By means of a time-series analysis, we determined the historical development of performance in decathlon for men in the Czech Republic. Using athletic yearbooks, we extracted the top ten best results in 65 athletic seasons for each year. Based on the best scored performances of the top ten Czech competitors in each year, we ascertained the course of performance in the men's decathlon from 1955 to the present (2019). The year 2020 was not included for the reason of the very small number of competitions held. Competitions were cancelled for epidemiological reasons (Covid-19). This development of the performance value in decathlon during 1955-2019 is reflected graphically for the first top ten competitors and, in annual tables, using the example of the first, fifth and tenth competitors. The graph also clearly depicts the development trend of decathlon performance in the Czech Republic during the period under review.

Within the study, we posed the following research questions: Did the performance in the men's decathlon improve during the period under review? Which athletes were the greatest influence on the development of the Czech leading competitors? Is the best competitor's performance related to that of the wider range of top competitors? In the set under study, we included the top ten decathlon performances in decathlon in the individual years in the Czech Republic during the period under review, i.e. 1955-2019. Data were collected based on an analysis of documents. To process and evaluate the study, we chose the method of an analysis of time series, which illustrate the development of decathlon performances in the men's decathlon in the Czech Republic.

We have observed the course of scores of the annual performances of the best decathletes of the season, pointing at the absolute top performance, the fifth and tenth best performances of the season, which is indicative of the wider range of top competitors. To determine the development trends, we have also worked with the average values of the top ten competitors in the seasons and have monitored the year-to-year changes of these performances between 1955 and 2019: accordingly, this is a longitudinal analysis.

The study compares the best decathlon performances of the individual years under review. The data were taken from yearbooks of the Czech Association of Athletics (ČAS) and the Czech National Sports Council (ČSTV), which are now available on the respective websites. The performances were assessed according to internationally recognized scoring tables for decathlon events. For the section

of development of decathlon performances (1955-2019) analysed by us, the scoring tables underwent changes in 1950-52, 1962 and 1985. For comparison, all performances from 1955 were recalculated according to the latest internationally valid tables. The year 1955 was chosen as the beginning of the period under review due to the lack of data in the previous period after World War II. Until 1968, tables with results of Czech competitors were used, from 1969, we worked with Czech tables. The efforts to select only Czech decathletes from the tables before 1969 were unsuccessful since the tables did not provide any information on the athletes' nationality. Accordingly, it was impossible to select Czech athletes from the tables.

Using Spearman's correlation coefficient, a correlation analysis was conducted for performances in the first, fifth and tenth places in the annual tables to determine the correlation of the performance level in these places. The critical value of Spearman's correlation coefficient at the level $\alpha = 0,05$ for 65 variables is 0.244.

Results and discussion

World War II brought with it a devasting effect on all sports disciplines. Nonetheless, after World War II, there has been a steady improvement in performance in all sports disciplines, and this is including decathlon. The performance curve of the average performance of the top ten athletes had a growing trend approximately until 2002, with some stagnation between 1975 and 1990 (Figure 1). After that year, there has been a decline in performance and subsequent stagnation of performance until the present.
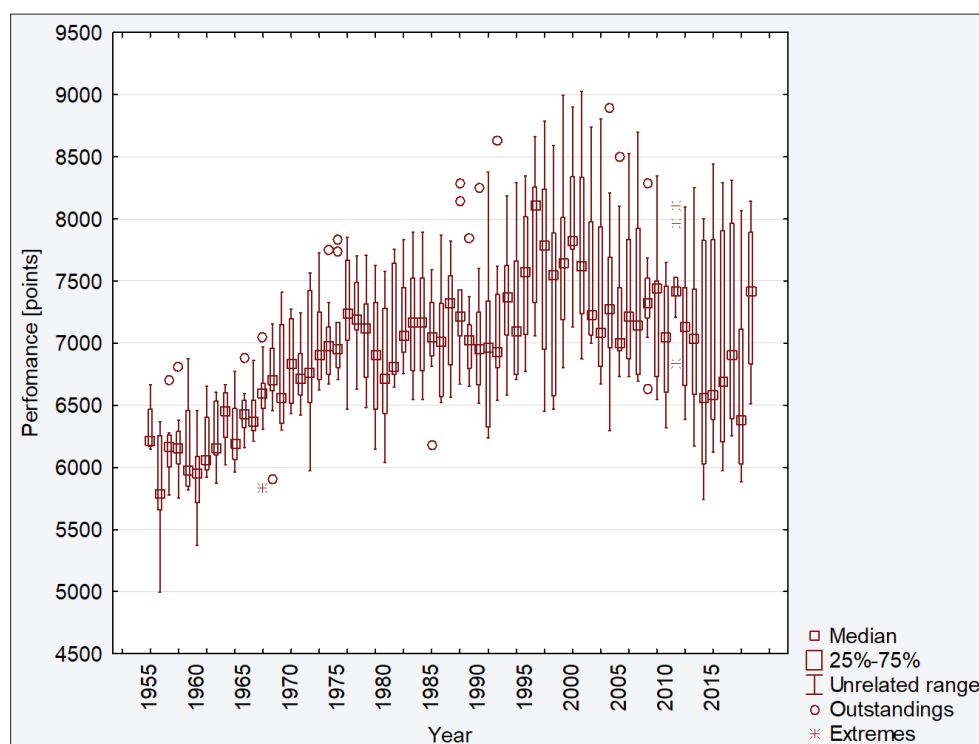

Figure 1./ Obrázek 1.
Development of performance in decathlon between 1955 and 2019 for the top ten athletes in annual tables./ Vývoj hodnoty výkonu v desetiboji v letech 1955–2019 prvních deseti závodníků v ročních tabulkách.

The course of the performance curve for the average of the top ten performances (Figure 1) initially shows a rise, which began due to the post-war reconstruction of society and development of the sports system. Decathlon saw the period of a steady fast development of performance, which lasted until 1975. Clubs were founded and expanded, stadiums were constructed, and training methods were developed. Conditions for the development in the society and sports were unique from the today's

point of view, and thus allowed a continuous growth in performance. Slowdown in the growth in performance occurred in the mid-1980's and a certain stagnation was apparent until 1990. Unlike in other sports disciplines, where social changes in the Velvet Revolution year, mainly the reduction in the state support, leading to the collapse of the sports support system (Bahenský, 2017), and causing a decline in performance from 1990, performance growth kicked off again in decathlon. The trend of the performance curve for the best performance of the season and for the set of the average of the top ten decathletes from 1989 until 2002 had an increasing level. This was followed by a rather declining performance up to the present, with a slight performance in the years 2010 and 2019. These developments are different from those in other athletic disciplines (Bahenský, 2017, Kursová, 2019).
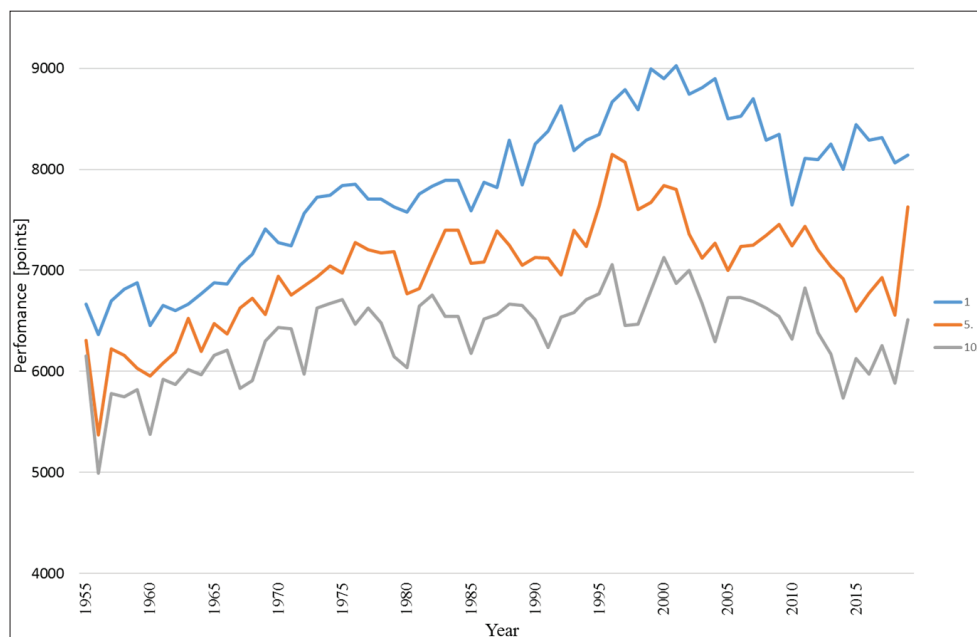

Figure 2./ Obrázek 2.

Development of the value of performance in decathlon between 1955 and 2019 using an example of the 1st, 5th and 10th competitors in annual tables./ Vývoj hodnoty výkonu v desetiboji v letech 1955–2019 na příkladu 1., 5. a 10. závodníka v ročních tabulkách.

The most significant variable factors of the development of the performance curve are considered to be the athletes whose scores noticeably exceed those of the other athletes. The results of the first, fifth and tenth decathletes in the period between 1955 and 2019 vary most in the period from 1995 to 2002 (Figure 2). Moreover, Figure 3 clearly shows the period when the difference between the best and the tenth athletes in the annual tables was greatest. These data also illustrate the fact that the 1990's saw a relatively large difference between the best and the tenth athletes in the annual tables, thanks to the world-class level of the leading competitors. These results were largely contributed to by Robert Změlík, Tomáš Dvořák and Roman Šebrle in that period. During 2014–2016, the reason for the even greater standard deviation of the top ten annual performance is seen in the rather lower level of performance of the wider range of national top athletes, rather than a high level of the best athletes.

Our best decathletes took turns at the top, "passing the baton". Robert Změlík was replaced by Tomáš Dvořák, who was later replaced by Roman Šebrle. They always competed together and subsequently, they alternated each other at the top of the Czech and world athletics. Roman Šebrle was replaced by Adam Sebastian Helcelet, who has competed to date, though not with the same success as the decathletes before him achieved.

Among other aspects, the above-named sportsmen's efficiency contributed to their extraordinary performance. For example, Tomáš Dvořák's efficiency of his decathlon world record performance stood at 99.89% and that of Roman Šebrle even exceeded the one-hundred percent value at 100.33%. These

numbers are very surprising, especially with respect to the fact that every discipline completed may have a negative impact on the readiness to perform greatly in the next discipline, and thus tiredness adds up.
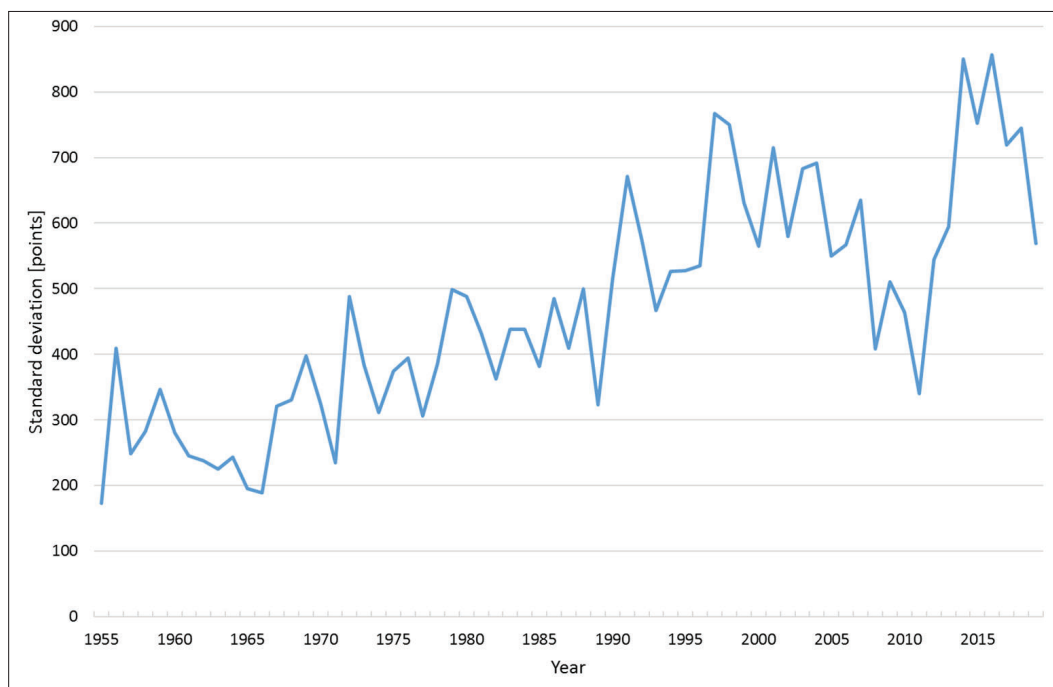

Figure 3./ Obrázek 3.
Standard deviation of the top ten performances in each year between 1955 and 2019./ Směrodatná odchylka nejlepších deseti výkonů v každém roce v letech 1955–2019.

Table 1./ Tabulka 1.
The best decathletes in the history of the Czech Republic./ Nejlepší desetibojaři historie České republiky.

Ranking	Performance	Surname and first name
1.	9026	Šebrle Roman
2.	8994	Dvořák Tomáš
3.	8627	Změlík Robert
4.	8339	Ryba Jiří
5.	8335	Helcelet Adam Sebastien
6.	8314	Poděbradský Jan
7.	8289	Valenta Věroslav
8.	8256	Damašek Kamil
9.	8142	Doležal Jan
10.	8141	Hrabaň Roman
11.	8122	Sýkora Jiří
12.	7967	Lukáš Marek
13.	7941	Machura Martin
14.	7922	Karas Josef
15.	7834	Sóldos Peter
16.	7801	Pastrňák Aleš
17.	7756	Komenda Tomáš
18.	7748	Knejp Jiří
19.	7683	Sajdok Stanislav
20.	7667	Šářec Petr

Robert Změlík is the 1992 Olympics winner and the 1997 world champion in the indoor heptathlon. He was the first Czechoslovak Olympics decathlon champion. Rober Změlík's strength included the long jump, 110 m hurdles, 100 m sprint and 1,500 m run. On the other hand, his weaknesses were the shot put and throws. He retired from his sports career as young as 29 in the year 1998 (Jirka et al., 2013).

Tomáš Dvořák is a three-time world champion in decathlon in 1997, 1999 and 2001. He won the European championship in 2000 and took silver in the world heptathlon championship in 2002. He ended his career in 2008. Tomáš Dvořák was an excellent hurdler and long jumper who broke the eight-meter threshold. His personal decathlon record is only six points away from the 9,000-point mark (Jirka et al., 2013).

Roman Šebrle is the 2004 Olympics winner and a silver medallist in the 2000 Summer Olympics, the 2007 world champion, and European champion in 2002 and 2006. He was the first decathlete in the world to break the 9,000-point mark.

Table 1 shows personal records of the top twenty decathletes in the history of the Czech Republic. Here, too, the distance between the first two or three decathletes from the remaining athletes is apparent. Table 2 provides values of the correlation coefficient. All the values stated exceed the critical value of Spearman's correlation coefficient. It can be said that the performance of the wider range of top athletes significantly correlated with the performance of the best athlete. This confirms the efforts to maximize the performance of the wider group of athletes and to encourage a larger number of athletes in the given discipline.

Table 2./ Tabulka 2.
Spearman's correlation coefficient among the 1st, 5th and 10th performances in each year between 1955 and 2019./ Spearmanův korelační koeficient mezi 1., 5. a 10. výkonem v každém roce v období 1955–2019.

	1.	5.	10.
1.	-	0,830	0,720
5.	0,830	-	0,823
10.	0,720	0,823	-

Note: All values given in the Table are statistically significant at the level $\alpha = 0.05$.
Poznámka: všechny hodnoty uvedené v tabulce jsou statisticky významné na hladině $\alpha = 0,05$.

Conclusions

This study presents the development of performance in decathlon during the period from 1955 to the present. The greatest upswing began after the war, especially thanks to the intensive support provided by the government. The performance level would grow until the mid-1980's. This trend was replaced by a certain decline or stagnation until 1990. Then a growth in performance in decathlon re-emerges and continues until 2002, mainly influenced by strong individualities in this sport. From then to the present, there has been a decline in performance and a subsequent stagnation.

Unlike in the case of other athletic disciplines, the peak period of performance in the men's decathlon falls within the period of the turn of the 20th and 21th centuries. The results show that the best performances were recorded between 1995 and 2002, not only for the best athlete, but also for the wider range of national top athletes (the fifth and tenth best athlete of the year). We may ask to what extent these performances were influenced by the individualities who are not born every year, or what role the effect of group training played (placing the best athletes in one training group and healthy rivalry among athletes), or how important the exchange of experience between successful athletes' coaches or the system of sports support were. Importantly, in running disciplines (except for 800 m run), the best performances were achieved at the turn of 1970's and 1980's; after 1989, there was a significant decline in performance, similar to other athletic disciplines (Bahenský, 2017).

Currently, the average performance level of the top ten decathletes is found to be at low levels corresponding to the period between 1965 and 1970. The question remains the future development of this disciplines, which awaits other individualities of the type Změlík, Dvořák or Šebrle. At present, regarding the individual development of performance of Czech decathletes Adam Sebastian Helcelet

and Eliška Klučinová, a note is made of the high effectivity of their best decathlon performance and a steady progress of their performance. However, the today's best Czech decathletes lag behind the world's leading decathletes in sprint disciplines.

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