Success of elite adolescent female runners in adulthood

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Abstract

Every talented sportsperson should be developed by an optimal training load applied in order to achieve her limit performance capacity by training adequate to the given age, with no early specialization. This opinion has been confirmed by our study. Through an analysis of the performance capacity of the best female runners of the Czech Republic in youth categories and in adulthood, we examined the link between the performance capacity of female runners in adolescence and that in adulthood. Elite adolescent female runners achieved a considerably lower limit performance capacity in comparison with elite adult female runners. This is probably caused by accelerated performance development. Moreover, the former achieve the top performance level earlier than usual. While the age of the top performance capacity in the best adult female runners is 26.0 ± 3.8 years for 800m, 25.0 ± 3.1 years for 1,500m and 26.0 ± 3.1 years for 3,000m, elite of U20 female runners reach their top performance capacity at the age of 21.1 ± 3.1 for 800m, 21.0 ± 3,4 for 1,500m and 22,0 ± 3,5 for 3,000m, of U18 females at the age of 19.1 ± 2.7 for 800m, 19.3 ± 3.5 for 1,500m and 20.7 ± 4.1 for 3,000m, and in case of U16 at 16.6 ± 2.8 years for 800m, 18.0 ± 4.2 years for 1,500m and 17.4 ± 3.5 years for 3,000m. Only a small percentage of elite adolescent female runners is able to improve their performance in adulthood. The top performance capacity in the adolescent age does not vouch for the top performance capacity in adulthood nor is it a guarantee for an individual limit performance capacity.

Key words: *Run, adolescents – girls, talent, development of performance capacity, early specialization.*

INTRODUCTION

Although female running disciplines (medium and long tracks) may not be those of the most successful group of disciplines in the Czech athletics, our history is abundant with female runners whom we have every right to be proud of. An indelible mark on our sports history was made by Jarmila Kratochvílová, Ludmila Formanová, Jaroslava Jehličková, Ivana Kleinová (Walterová-Kubešová), Milena Matějkovičová, or Zuzana Moravčíková. With the view of the size of the base of runners, it is necessary to try and develop each talent we discover to ensure that their dispositions develop. This presupposition is even more important in the light of the fact that male and female runners from our region do not have ideal prerequisites for medium and long tracks in comparison with other ethnic groups (Grasgruber & Cacek, 2008). For a talented runner to fully realize his/her dispositions, a many-year cultivation and the fulfilment of certain conditions for sports development are required. The ultimate top sports performance is a result made of talent and training (Bunc, 2004). In cultivating a sports talent, it is imperative to respect general biological regularities, which will enable the given individual to reach the maximum performance at an optimal age (Hofmann & Schneider, 1985; Malina, 1993; Malina, Bouchard & Bar-Or, 2004; Písařík & Liška, 1985). The level of sports performance capacity is influenced, in addition to the chronological age, by the biological age and its implications (Schnabel, Harre & Krug, 2008). The effect of the biological age, mainly in the pubescence period, is critical for motoric performance, functional indicators of the organism and the body build (Dovalil et al., 2005; Malina & Bouchard, 1991; Zmajic, 1996). The biological age does not always correspond to the chronological age.

Women, when maturing, undergo physiological and morphological changes, which may cause a drop in the endurance, strength and speed levels. In addition, women have a relative larger quantity of fat than men; this difference is even more prominent in pubescence. Growing and other pubescent changes are completed for girls between ages from 16 to 17. This is a period when a certain stagnation in performance capacity may emerge (Máček & Radvanský, 2011).

A large number of male and female runners finish their sports careers around the age of 17; in other words, at the age when they are far from reaching their top performance capacity (Bahenský & Semerád, 2016; Enoksen, 2011). Reasons for an early termination of sports career across various types of sports vary: sometimes, performance indicators are to blame, or the reason is training conditions, obligations related to work or study, motivation, social situation, switchover between various types of sports, etc. The age most often mentioned in connection with the top performance capacity is the interval between 24 and 26 years (Dovalil et al., 2005) or 24 and 30 years (Moss, 2004; Vobr, 2009). These data correspond to the curve of development of values VO_2max according to the given age. In running disciplines, the age of top performance capacity tallies with the period of maximum oxygen consumption (Neumann, Pfützner & Berbalk, 2000). This is one of the reasons why to accelerate sports development for (not only) female runners is unsuitable (Dovalil et al., 2005; Kampmiller et al., 2012).

Optimum development of performance capacity may be disrupted by endogenous and exogenous effects; *inter alia*, by the fact that certain youth sports coaches are unable to rise above their craving for immediate success. Importantly, objectives of individual preparation stages must be accomplished (Birrer, Griesemer, & Cataletto, 2002; Dovalil et al., 2005). Sports preparation of the youth is not the same as that of adults. In adolescence, the essential objectives of sports training consist in creating the base for training later in life (Arens, 1983; Bompa, 2000; Perič, 2004). Unless the principles of training for the age concerned are observed, early specialization sets in, and, as a consequence, the growth of performance capacity is accelerated and the final performance potential in adulthood decreases, the performance capacity stagnates around the age of 18, injuries tend to occur more often and there occurs a loss of motivation (Dovalil et al., 2005; Drabik, 1996; Feige, 1973; Helgerud et al., 2007; Moss & Dick, 2004).

OBJECTIVE

The objective of the paper is to determine and evaluate the success of a selected set of the best Czech youth female runners in medium and long track runs in adulthood. Our results may reveal effects of early specialization.

METHODOLOGY

In terms of time, the subject of our research is centred on the period from 1960 to 2018. The examined sets include only those female runners for whom, at the moment of performance of the study, at least four years elapsed from the moment when they had achieved the best performance in the given discipline, or, as the case may be, female runners who reached at least an average age of the top performance capacity determined in each discipline. We evaluated performance capacity separately in the following individual categories: U16 (up to 15 years of age, including), U18 (up to 17 years of age, including) and U20 (up to 19 years of age, including) and in the category of women. The observed disciplines were: medium (800m and 1,500m) and long tracks (3,000m) – master disciplines of youth categories, track without hurdles. Performance data for both outdoor and indoor were used. The criterion for including a subject into the observed set

was the placement in no worse than the 20th position in historical tables of the given discipline and category in the Czech Republic.

Performance data were derived from the website of the Czech Athletic Federation (ČAS) in the section Statistics and from respective annuals of the Czech Athletic Federation, or the Athletic Federation of the Czech Central Committee, Czech Association of Physical Education (ČÚV ČSTV).

The observed set was examined for the age of reaching the top performance capacity – personal best (PB) time. The 3,000m run served as a master category of women until the year 1994, and was replaced in 1995 with the 5,000m run, which, as a result, consolidated the range of disciplines with the male category. The 5,000m track is not a master discipline for youth categories and, as such, it was not included in our study.

Cohen's d was used for determining the substantive significance of the difference between the performance capacity level of the best female runners in the adult category and the youth categories in the individual disciplines in the Czech Republic. This parameter was applied to ascertain the substantive significance of difference in the ages of the top performance capacity of elite women in the adult category and the age when elite female runners reach their limit performance capacity (personal best time) in the individual youth categories in the respective disciplines. The data were processed using Microsoft Excel 2016 and Statistica 12. The average value of processed data and the standard deviation are given.

RESULTS

Figures 1 to 3 present performance data of the twenty best female runners in the Czech Republic in the categories of U16, U18 and U20 and in the category of adults in disciplines 800m, 1,500m and 3,000m. These figures show how the performance level of elite female runners have changed with their age in the individual categories. The greatest increase in performance capacity, save for the 3,000m run, appears between the category of U20 and the category of adults (by 4.17% for 800m, by 4.84% for 1,500m and by 5.39% for 3,000m), and the lowest increase was found to happen between the category of U18 and U20 (by 2.14% for 800m, by 1.95% for 1,500m and by 1.93% for 3,000m. Between categories of U16 and U18 show in increase by 3.45% for 800m, by 4.66% for 1,500m and by 5.79% for 3,000m.
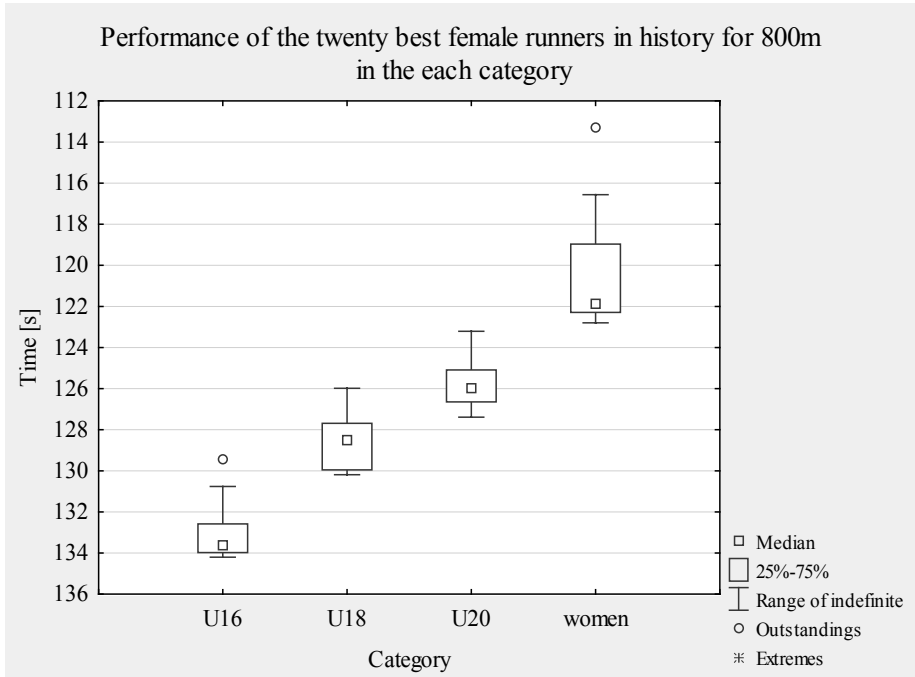
Fig. 1: Performance of the twenty best female runners in history for 800m in the each category
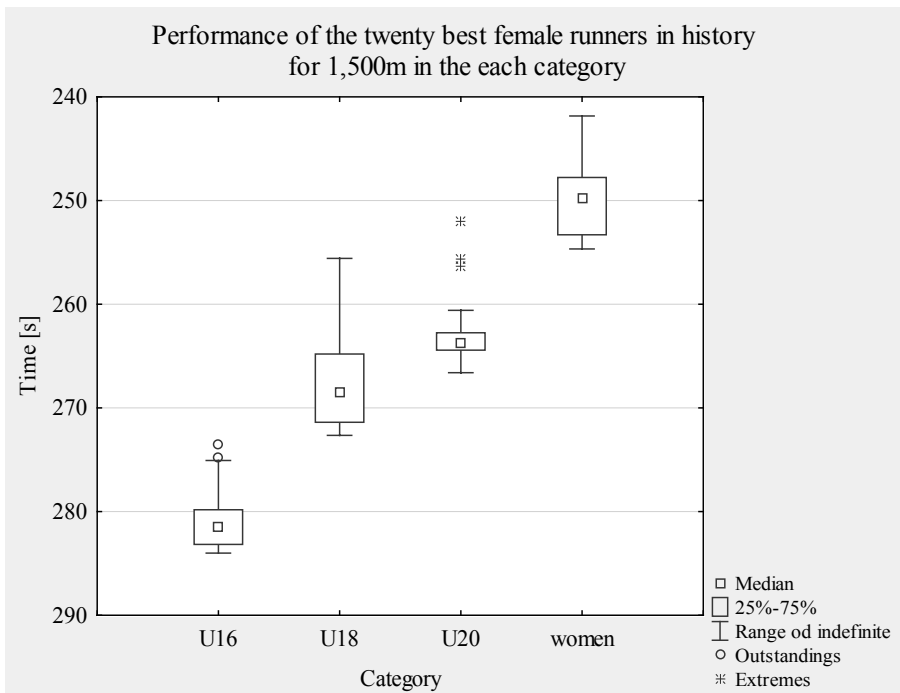

Fig. 2: Performance of the twenty best female runners in history for 1,500m in the each category
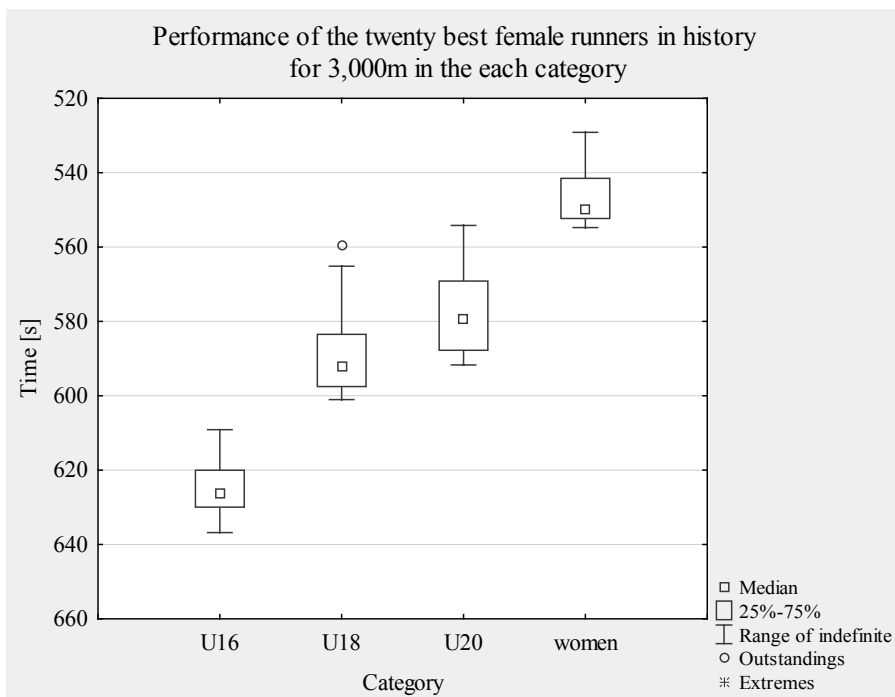
Fig. 3: Performance of the twenty best female runners in history for 3,000m in the each category

Tables 1–3 present the significance of differences in personal best times achieved by elite female runners in the individual categories. The coefficient shows the difference in the limit performance reached by female runners who ranked among the top young sportspeople up to 15, 17 and 19 years of age in comparison with women who are at the absolute top level in the category of adult women. The younger category of elite female runners, the larger difference in the achieved personal record in comparison with performance in the category of adults.

Tab. 1: Substantive significance (Cohen's d) of differences in achieved PB times of the twenty best female runners in the individual categories and the adult top female runners in Czech Republic in 800m run

800m	U16	U18	U20	women
U16		1,39	2,20	3,17
U18	1,39		0,92	2,06
U20	2,20	0,92		1,18
women	3,17	2,06	1,18	

Tab. 2: Substantive significance (Cohen's d) of differences in achieved PB times of the twenty best female runners in the individual categories and the adult top female runners in Czech Republic in 1,500m run

1500m	U16	U18	U20	women
U16		0,88	1,59	2,80
U18	0,88		0,64	1,69
U20	1,59	0,64		1,08
women	2,80	1,69	1,08	

Tab. 3: Substantive significance (Cohen's d) of differences in achieved PB times of the twenty best female runners in the individual categories and the adult top female runners in Czech Republic in 3,000m run

3000m	U16	U18	U20	women
U16		1,20	1,68	2,82
U18	1,20		0,51	1,88
U20	1,68	0,51		1,52
women	2,82	1,88	1,52	

Table 4 presents the average age when the top performance (personal best time) is reached by female runners of the individual sets in the observed disciplines. The younger set, the lower age of the top performance capacity. The largest differences in the ages of the top performance capacity between the youth sets and the adult set were found in the 800m run, and lowest differences were identified in the 1,500m run. Similarly, in the category of U20, the age of the top performance capacity is considerably lower than that the top performance capacity of the best female runners in the category of adults, and, as in the category of U16 and U18, this difference is significant with a large effect, see Tables 5–7.

Tab. 4: Age (in years) when the top performance (PB time) is reached by female runners in the individual categories and disciplines in Czech Republic

	top U16	top U18	top U20	top women
800 m	16,6 ± 2,8	19,1 ± 2,7	21,1 ± 3,1	26,0 ± 3,8
1500 m	18,0 ± 4,2	19,3 ± 3,5	21,0 ± 3,4	25,0 ± 3,1
3000 m	17,4 ± 3,5	20,7 ± 4,1	22,0 ± 3,5	26,0 ± 3,1

Distribution of the age of top performance capacity in the individual sets is illustrated in figures 4–7.
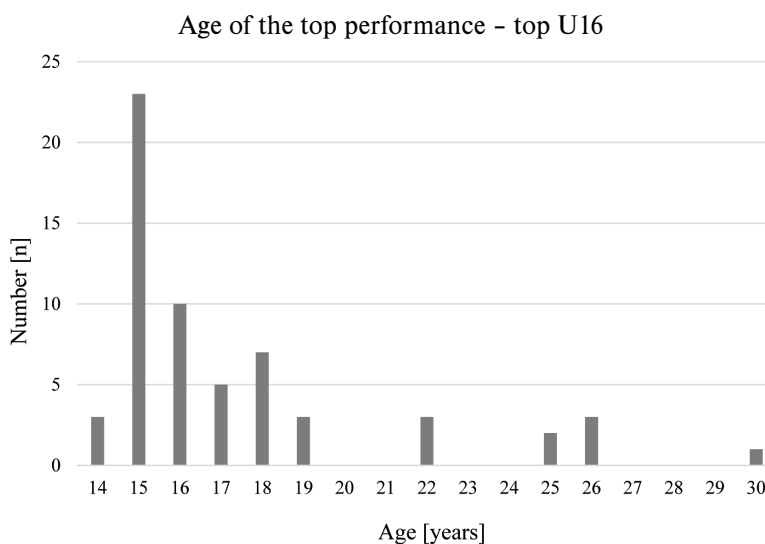
Fig. 4: Age of reaching the personal best time by the twenty best female runners in the category of U16 in 800m, 1,500m and 3,000m runs in Czech Republic

Age of the top performance – top U18

Fig. 5: Age of reaching the personal best time by the twenty best female runners in the category of U18 in 800m, 1,500m and 3,000m runs in Czech Republic

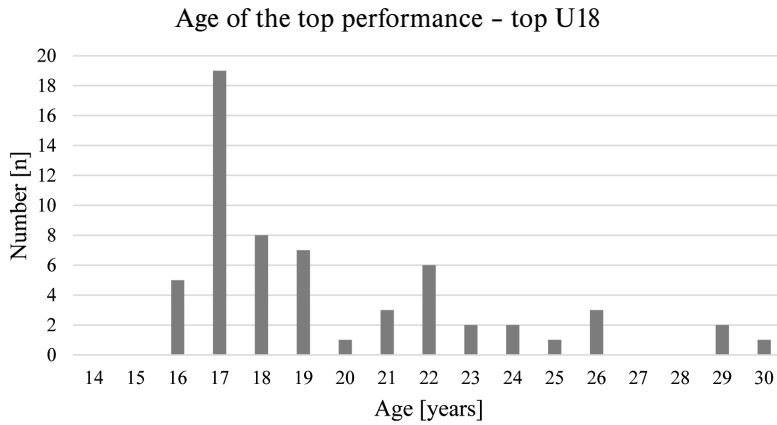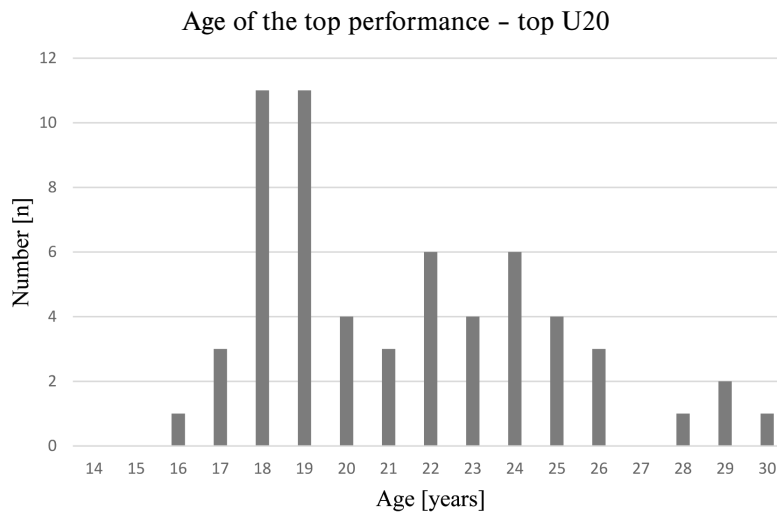Age of the top performance – top U20

Fig. 6: Age of reaching the personal best time by the twenty best female runners in the category of U20 in 800m, 1,500m and 3,000m runs in Czech Republic
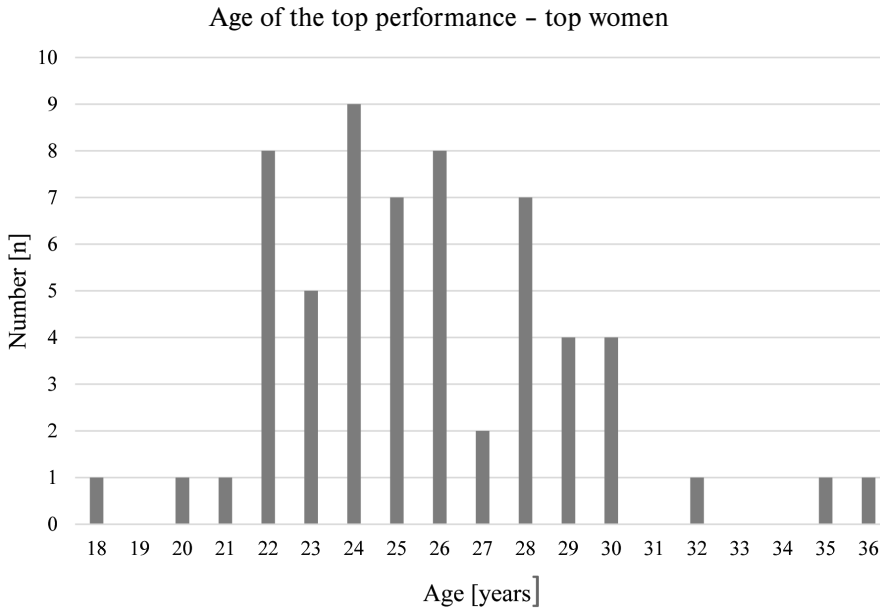
Fig. 7: Age of reaching the personal best time by the twenty best female runners in the category of women in 800m, 1,500m and 3,000m runs in Czech Republic

Figures 4–7 clearly show that of the twenty best female runners in each observed discipline in the category of U16, the personal best time is reached by as many as 85% at the age of 15–19. Only 5% of female runners reached their personal best time at the age of 20–23 and the remaining 10% is made up of those female runners who reached their best performance at the age of 24 or later. Of the historical top twenty female runners in the category of U18, the best performance was achieved by 65% of female runners at the age of 15–19. At the ages from 20 to 23, the best performance was reached by 20% of female runners, and at the age over 24, 15% of female runners noted their best performance. In the of U20 set, 43.33% of female runners achieved their best performance capacity before the age of 19, other 28.33% of female runners reached their best performance at the ages from 20 to 23 years, and for 28.33% of female runners, the best performance came at the age of 24 years and later. In the category of adult women, 1.67% of female runners achieved their best performance capacity before the age of 19, for other 26.67% of female runners, the best performance was accomplished at the ages from 20 to 23, and for 71.67% of female racers, the best performance came at the age of 24 years and later.

Tables 5–7 show the significance of the difference in the current age in reaching the limit performance capacity (personal best time) among the individual sets of female runners. The coefficient shows the difference in the limit performance reached by girls who ranked among the top young sportswomen up to 15, 17 and 19 years of age in comparison with women who are at the absolute top level in the category of adult women.

Tab. 5: Substantive significance (Cohen's d) of differences in age of achievement PB times of the best female runners in the individual categories and the adult top female runners in Czech Republic in 800m

800m	U16	U18	U20	women
U16		2,73	2,96	3,30
U18	2,73		2,93	3,27
U20	2,96	2,93		3,46
women	3,30	3,27	3,46	

Tab. 6: Substantive significance (Cohen's d) of differences in age of achievement PB times of the best female runners in the individual categories and the adult top female runners in Czech Republic 1,500m run

1500m	U16	U18	U20	women
U16		3,87	3,80	3,67
U18	3,87		3,47	3,34
U20	3,80	3,47		3,26
women	3,67	3,34	3,26	

Tab. 7: Substantive significance (Cohen's d) of differences in age of achievement PB times of the best female runners in the individual categories and the adult top female runners in Czech Republic in 3,000m run

3000m	U16	U18	U20	women
U16		3,77	3,48	3,28
U18	3,77		3,79	3,60
U20	3,48	3,79		3,31
women	3,28	3,60	3,31	

Of 60 elite adult female runners, only 22 (8 female runners for 800m, 9 female runners for 1,500m and 5 female runners for 3,000m) appeared among the twenty best racers in the youth categories, see Table 8. However, in the category of U16, only 6.7% of female runners demonstrated the elite performance capacity, in the category of U18, the elite performance capacity was reached by 25% of female runners, and by 36.7% female runners in the category of U20.

Tab. 8: Number of runners whose placement was no worse than the 20th position in historical tables for 800m, 1,500m a 3,000m runs in the adult category and who, at the same time, figure no worse than in the 20th position in youth categories

	U16	U18	U20
800 m	1	4	8
1500 m	1	6	9
3000 m	2	4	5

DISCUSSION

The 1970s and 1980s saw a large portion of the best performance on the track accomplished by the category of women; however, the dominance of this period is not as prevailing as that in male categories (Bahenský, 2017; Bahenský & Semerád, 2014; Bahenský & Semerád, 2016). As regards women, unlike male categories, data in tables change considerably even today, i.e. after the year 2010. The age of the top performance of our set is compliant with values reported in literature for all disciplines (Dovalil et al., 2005; Moss, 2004; Vobr, 2009). In comparison with the age of the top performance capacity of elite adult female runners, the age of the top performance capacity in the set of elite female runners in the individual youth categories is significantly lower; it will be significantly lower the younger the age of the set of female runners. The difference between the age of the top performance capacity in sets of elite adolescent female runners and that of the set of adult elite female runners in long tracks is not noticeably lower when compared with medium tracks in female categories. This is the aspect which distinguishes categories of women from categories of men (Bahenský & Semerád, 2016). When compared with boys of U16 and boys of U18, a significantly larger percentage girls of U16 and U18 reach the maximum performance capacity before the age of 17, and then they improve no longer. This study is not concerned with the determination of causes of the small percentage of elite U16 who improve their performance capacity until they reach adulthood. Needless to say, this condition is also affected by changes caused by puberty. Physiological changes that take place in girls during puberty do not in fact support the maximum performance in medium and long tracks (Máček & Radvanský, 2011). Another cause may be seen in early specialization of female runners, the biological age, social situation and other factors. The data of our study confirm that one of the conditions of the top elite performance capacity is a many-year systematic work, and the physical and emotional maturity of individuals (Bompa, 2000; Dovalil et al., 2005; Perič, 2004). These criteria are not met by adolescent female runners, especially at the category of U16, which is the reason why their performance does not approach the performance capacity of elite adult runners. As a matter of fact, the elite set of U16 is not a ticket to elite female runners in adulthood. In the category of U18, one fourth of elite female runners maintained their position in the Czech top sports base until adulthood. In the category of U20, this was accomplished by less than one half of female runners, excepting the 3,000 run, where the road to the top performance capacity takes more time (Vobr, 2009). Our results considered, it may be stated that the most suitable variant of reaching the top national level in adulthood is to accomplish this level only in adulthood or at the category of U20.

CONCLUSION

Our study suggests that to belong to the top at the adolescent age does not necessarily mean that one will belong to that same group in adulthood, whatever the reasons for performance stagnation or for termination of running career before the end of the biological development may be. There may be female runners who have managed to assert themselves from the category of U16 to adulthood, but these are outright exceptions. Obviously, at the adolescent age is a direct proportion between the age of reaching the elite performance level in the scope of the Czech Republic and the performance level (PB time value) in adulthood (the higher age, the higher level). Results of our study confirm that the top performance capacity of female runners in medium and long tracks at the adolescent age does not guarantee the accomplishment of an individual limit performance capacity. We do not recommend accelerating the performance of female runners by early specialization. Emphasis on performance in adolescent age also does not benefit to performance

level in adult age. However, there is no universal recipe for achieving top performance in adult age, which is applicable to everyone.

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