SECTION – SPORT SCIENCES

(1.2) DOI: 10.5604/01.3001.0015.7372

RUNNING ACTIVITY, PREPARATION AND PARTICIPATION IN MARATHON RUNS BY AMATEURS BETWEEN THE AGE OF 42-51 – A CASE STUDY

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Authors' contribution:

A. Study design/planning
B. Data collection/entry
C. Data analysis/statistics
D. Data interpretation
E. Preparation of manuscript
F. Literature analysis/search
G. Funds collection

Article received: 0;
Accepted: 0
Published: 0

Keywords: masters runner, marathon, activity

Abstract:

Aim. In the research, we looked for the relationship between the level of training activity and aerobic capacity as well as the result in the marathon run by an amateur aged 42-51.

Materials and Methods. A progressive test was used to determine the threshold speed and load of the training activity. A 10-year period was analysed among amateur runners between the age of 42 and 51. The annual and DSP (Direct Start Preparation) training activity loads were determined. The strength of the relationship between the applied load of training activity and the result in the marathon was assessed, as well as the effectiveness of forecasting the result in the marathon.

Results. An average annual volume over 2,500 km (194 hours) was found. During the DSP period, there was definitely an increase in workload. On average, in the DSP, the sub-threshold, threshold and supra-threshold measures constituted 65.7%-19.4%-14.9%, respectively. A strong correlation was found between the result in the marathon and the annual volume, as well as the supra-threshold measures.

Conclusions. The examined person presented a high level of activity, which allowed to maintain a high and stable level in the marathon and a high level of efficiency expressed by the VO2max indicator. The high assessment of the progressive test in estimating the result in the marathon was confirmed.

Introduction

Nowadays, people in developed countries live 25-30 years longer than at the beginning of the previous century. The increase in life-span from decade to decade is becoming more and more noticeable. We are observing a demographic phenomenon, otherwise known as the "geriatric bomb" [1]. The changes taking place in society are not easy to define, let alone predict. However, it is certain that they will affect all spheres of life: economy, culture, education, tourism, economic and social welfare, free time, and most importantly health protection. People want to live not only longer, but most of all, in a state of full physical, intellectual and emotional fitness.

The goals and aspirations of older people are increasing. Movement is the basic attribute of life, and physical activity accompanies a person throughout life - from conception to one's final days. Maintaining in close relationships, most often, does not provoke reflection on its essence. Such considerations appear only in special situations, when the form of movement becomes a desired value [1].

Life can be divided into 2 basic stages [2]:

- the development period (growing, maturing, achieving one's highest level of biological fitness),
- the period of worsening homeostasis, the functions of certain organs, and a decrease in the ability to tolerate loads.

The second stage is the aging period, characterised by a gradual reduction in vital functions, increased morbidity, and ending in death. Aging is a natural, common and inevitable process. After a period of 20-25 years of growth and maturation, changes in structure and function progress. They are universal, spontaneous, gradual, irreversible and unfavourable. The effects of the changes concern various spheres, physical and mental efficiency decreases as well as physical fitness, and a loss in autonomy occurs. Due to their age, the elderly can be divided into several age groups. Contractual boundaries have been set by the World Health Organisation. They comprise: pre-old age (45-59), early old age (60-74), late old age (75-89), longevity (above the age of 90) [2].

Knowledge on the positive impact of activity does not always mean participation in activity [4], but the development of mass runs and the participation of an increasing number of participants in them is optimistic [5, 6]. The motives for participation in mass runs also differ depending on age [7]. In the case of the younger category, the result is more important, while in the older category - participation, meeting or attractiveness of the place are mentioned [8]. Another tendency was also found, in which pro-health behaviours including physical exercise, were considered risky to health [9,10]. There are also tendencies towards cross-country tourism [11]. In some reports, it is suggested that the longer the duration of activity, the greater the health benefits [12]. However, there are few studies in which running for a longer period of time would be evaluated. Most are based on short observations, usually 3-6 weeks. In a few cases, we are dealing with research on physical loads involving annual or long-term observations [13]. The few also include many years of observations regarding physical activity, considering not only the annual load but also direct start preparation (DSP).

Direct start preparation (DSP) is a special sub-period of the competition, lasting from 3 to 8 weeks, in which the body reaches its state of highest starting disposition, this primarily applying to professional athletes. In the case of amateurs, such preparation takes on a different form. It may be assumed that in the case of former athletes or such amateurs who are under the control of coaches, there will be similarities to classic DSP.

In the research, we searched for relationships occurring between the level of training activity and aerobic capacity, as well as the result in a marathon run by an amateur between the age of 42-51.

Research questions

- What activity is being performed compared to WHO recommendations?
- Does the performed activity allow for the maintenance of a high level of aerobic fitness?
- Did the implemented loads allow for their maintenance over the period of 10 years?
- Was the diagnostic value of the test used to estimate the marathon performance confirmed?

Research Materials and Methods

Research material

1. The research material is a documentation of running activity in the form of HR files (Fig. 1) regarding the applied running load, starts, progressive tests and official marathon results for individuals aged 42 -51 (2007-2016).
2. For recording HR, we used the Polar heart monitor (S 800i, RS 800, V 800) with updated somatic and physiological indices.
3. The examined person was 178-cm tall, while the average body mas was 69 kg (+/- 1 kg).

Research methods

1. The progressive test proposed by Żołądz was used to determine speed and threshold HR [14].
2. On the basis of the test, 3 training load zones were determined [15] (sub-threshold up to 95%, threshold 95% -100%, supra-threshold above the HR threshold).
3. Each DSP consisted of 8 weeks before the start in the marathon.
4. The results for the marathon were obtained from official announcements of the sports competition.
5. The official announcement from the competition was used to determine the speed in the marathon. In the absence of such information - a heart rate monitor equipped with GPS was applied.
6. VO2max was determined using the progressive test until refusal. The study was carried out as part of research projects in the years: 1986, 2011 and 2017.
7. The volume is expressed in hours, minutes and kilometres.

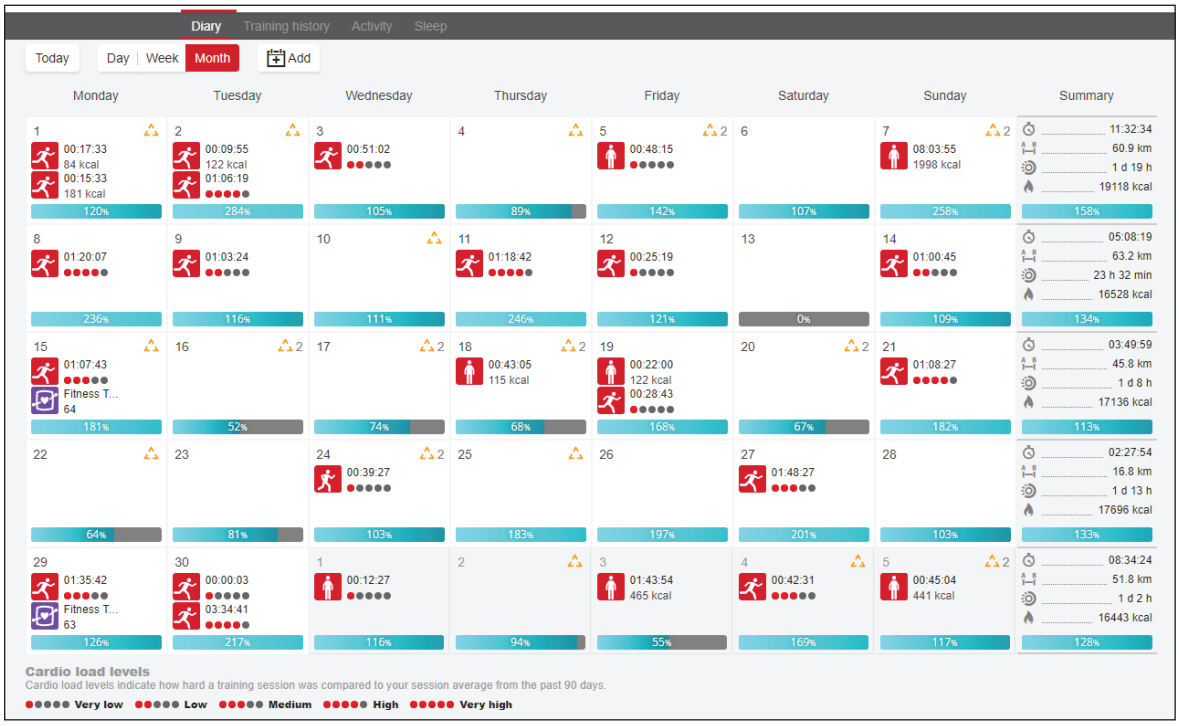


Figure 1. Example of the distribution regarding the subject's activity

8. The volume of training resources in DSP was calculated by totalling the time in individual load zones.
9. In order to describe the strength of the correlation between the training load and the result in the marathon, Spearman's signed rank correlation coefficient was used.

Results

Annual and DSP loads

In Graph 1, the annual volumes are expressed in kilometres, as well as the monthly average and the average for the entire period under study. During the entire period under study, 25,960 km were completed. The highest annual volume was 3,086 km (SD 385 km), with the average for the entire period equalling 2,595 km. The maximum monthly volume in the analysed period was 257.2 km (SD 32 km) with the average for the studied period being 216 km.

In Graph 2, data are presented on the time of activity and the weekly average in particular years. During the entire period under study, over 1,947 hours (1947:26:29) were devoted to physical activity, which averaged 194 hours and 45 min per year (SD 34 h 48 min).

The highest volume expressed in duration was found to be 237 h 28 min in 2011. In the analysed period (2007-2016), the average weekly activity was 224 minutes (SD 41 min). Compared to the weekly average in DSP prior to the marathon starts (Graph 3), a much higher volume of weekly activity in DSP was found, on average, by 100 min (45.9%).

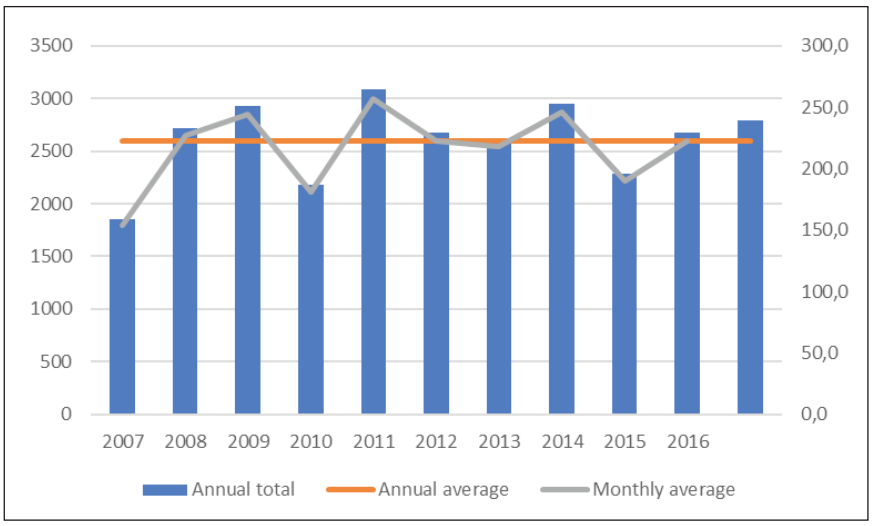
The data presented below were used to express the participant's direct preparation for the marathon.

In Graph 4, the volume is demonstrated for each of the 11 analysed DSPs before the start of the marathon. In 11 DSPs, the participant covered 6203.4 km, which is an average of 563.9 km per BPS and 70.5 km per weekly training microcycle. The DSP had the highest volume in 2013 (712 km), that is when the subject obtained the best result during the analysed period. The smallest volume was observed for the second DSP in 2007 (346.5 km).

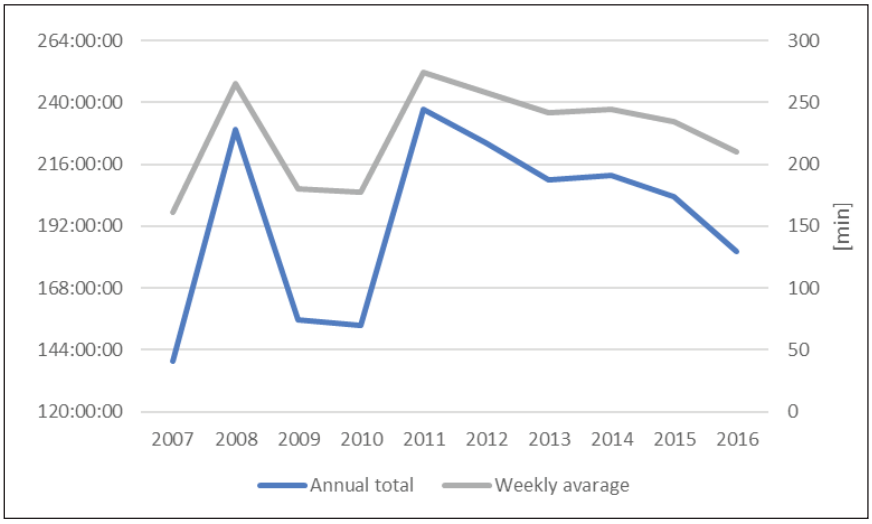
In Graph 5, the share is presented for individual training measure groups in preparation for the start in the marathon. In the best marathons in the years 2012 and 2013, the share of measures was 54.6-21.9-23.5 and 51.1-31.3-17.6, respectively.

Taking the average of all 11 DSPs into account, the share of sub-threshold, threshold and supra-threshold loads was 65.7%-19.4%-14.9%, respectively.

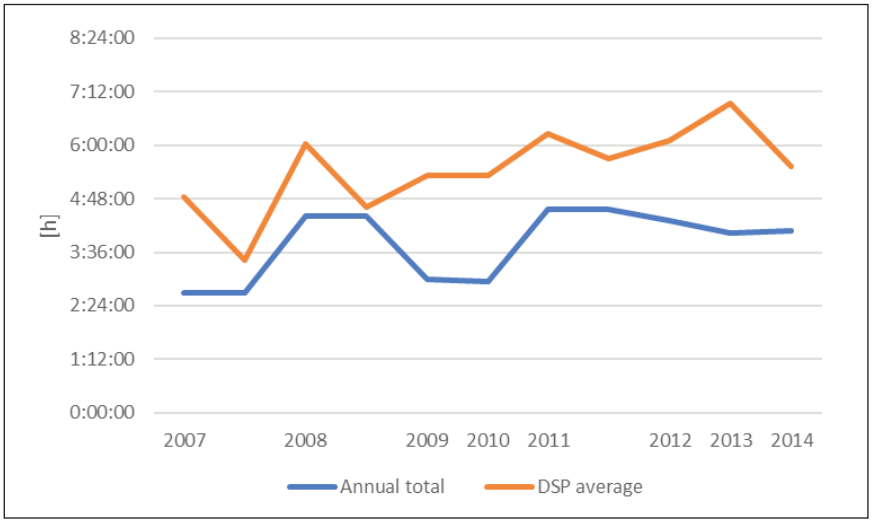
In Table 1, the correlation coefficient is shown between the marathon result and the training load. There was a low correlation between sub-threshold and threshold measures, a moderate correlation between DSP volume, and a high correlation between annual volume and supra-threshold measures.



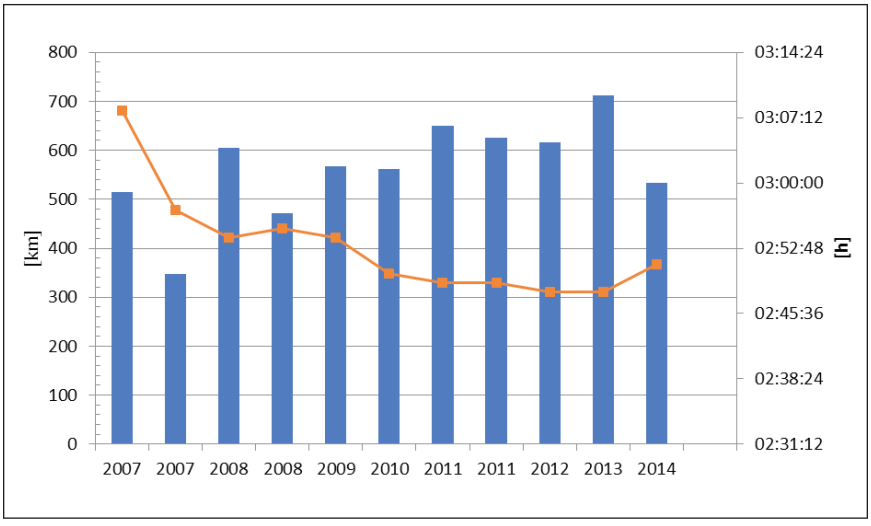
Graph 1. Annual volume [km], monthly and annual average for the study period



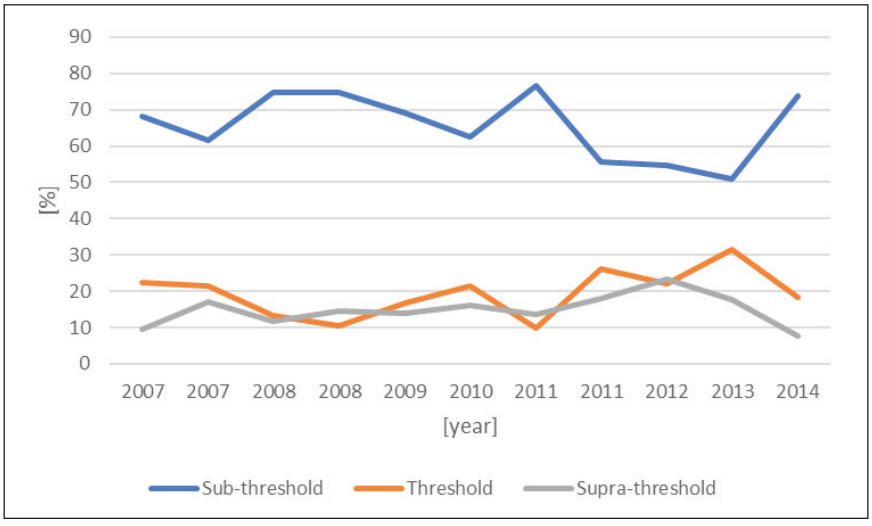
Graph 2. Annual volume [h], weekly and annual average for the period



Graph 3. Average weekly volume realised between 2007-2014 and in the DSP



Graph 4. Volume of work and time in the marathon for 11 individual DSPs



Graph 5. Percentage of measures in 3 training load zones for 11 individual DSPs

Table 1. Pearson's correlation coefficient between the result in the marathon and the volume of training resources in the DSP and annually

Training measures	Volume in DSP	Sub-threshold	Threshold	Supra-threshold	Annual volume
Pearson's correlation coefficient	-0.57	-0.27	-0.34	-0.67	-0.65

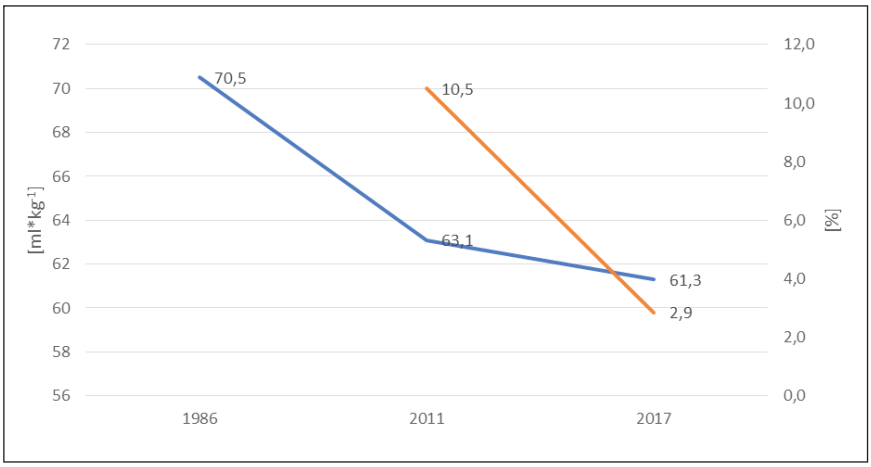
In Graph 4, the results are presented for measuring the efficiency of the examined person over a period of 31 years. The research was carried out as part of a statutory research project undertaken at the University of Physical Education (AWF) in Kraków.

According to the data, the value of the examined indicator decreased by 10 ml*kg-1 over 31 years, which constituted 15% of the maximal value. Between the studies in 2011 and 2017, the size of the changes was 2.9% (1.8 ml*kg-1).

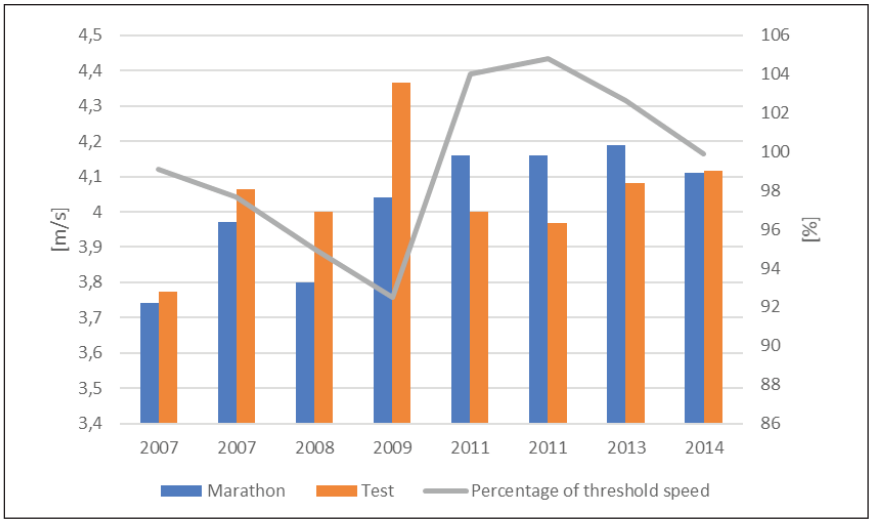
Starting and threshold speeds

Apart from determining the load zones during training units, the threshold test was also used to predict the result in the marathon. As suggested by Mirek et al. (16), the threshold speed determined in the test can be maintained for about 2.5 hours, therefore, the determined threshold speed before the start is important for predicting the result in the marathon.

In the above graph, the speeds are presented at which the participant ran the marathons (blue bars) and



Graph 6. VO2max values and percentage decreases in the periods: 1986-2011 and 2011-2017



Graph 7. Comparison w threshold and starting speed

the threshold speeds are marked in red, resulting from the previously conducted test. As can be seen from the presented graph, the threshold speeds in 5 cases were higher than those at which the subject ran the marathon. In t3 cases, the average speeds obtained in the marathon were higher than in the test. The differences, expressed as a percentage of the threshold speed, ranged from 93% to 105%. However, the average for all 8 marathons was 99%. Taking the marathon and the test with the greatest difference into account, the test overestimation was over 13 minutes, but when calculating the average threshold and starting speed for the 8 tests/marathon results, the difference would be approx. 1 minute.

Discussion

The best medicine to maintain high efficiency of the body for a long time and, at the same time, a satisfactory quality of life – is physical activity. The human body undergoes the aging process during ontogenesis, and the size of these changes depends on many factors. One of them is the lack of sufficient physical activity. Human evolution suggests that for health, it is necessary to be physically active. Inactivity has serious negative impact on health throughout life. Other lifestyle factors, such as nutrition, smoking or alcohol abuse and consumption, also negatively effect physiological function during aging.

The human body is designed to move and, according to some researchers, it looks good against the background of the natural world [17,18]. Also, for optimal functioning and avoiding diseases, physical activity, mainly aerobic activity, is needed, which helps to maintain the efficiency of the circulatory and respiratory systems [19]. Nowadays, the WHO's recommendations for weekly activity to maintain health range from 150 to 300 minutes a week. Due to the aging process of the organism and the associated reduced adaptation capabilities,

these recommendations apply to middle-aged and elderly individuals in a special way [20,21].

The most popular and accessible forms of endurance activity are: running, cycling, Nordic walking. The main influencing factors in endurance activities are undoubtedly aerobic capacity, the economy of exercise and the size of the lactate threshold [22]. According to the authors' knowledge, human performance decreases with age at an average of 10% per decade, while in people undertaking endurance activity, changes from the age of 35 to about 60-70 are curvilinear and then, exponential [23]. In documented research, results are given demonstrating lower regression in people who systematically perform physical activity, which may be about 5% per decade, but this decrease is not constant; it accelerates with each subsequent decade, especially in men, regardless of habits related to physical activity [24]. Of course, the situation is different in former athletes who, after a period of intense training, cease to be active. This is associated with a reduction 2-3 times greater than indicated above [25].

In their research, Pollock et al. [26] found that the performance of endurance athletes decreased after 20 years of follow-up, even if training intensity was continued at a high or moderate level. They also pointed out that continuous research is more accurate than cross-sectional studies. In other evaluations, the authors emphasized the importance of continuing the patterns used in earlier periods [27], and the reduction of intensity and volume is undoubtedly of decisive significance here [28].

A large drawback is the lack of continuous research covering the recording of the level of physical activity over prolonged periods of time. In the present work, a 10-year period is considered of recording HR files and evaluating the type of activity recorded using the Polar ProTrainer5 and Polar Flow programs.

During the entire 10-year period, the examined person spent over 1,947 hours on activity (mainly running), which amounted to about 195 hours per year. This volume is higher than that found in the research by Ratkowski [29] among amateurs running at a similar level. Considering the volume of the running measure, the annual average was 2,596 km (min-max 1,850-3,086 km), which is a volume greater than that found in Ratkowski's research carried out on amateur runners.

The weekly mean in the analysed period was 227.5 minutes (SD 41 min). Taking the WHO recommendations into account, the noted activity was within the recommended standards. The performed activity allowed to maintain a high level of aerobic capacity, i.e. above 60 ml*kg-1. From the presented data, between 1986 and 2011 (25 years), aerobic capacity decreased by 10.5%, and over the entire period of 31 years, by 13%. The average decline in endurance performance was 4.2% per decade, which may indicate a slowdown in the involution of endurance through physical activity of the examined person. This allows to confirm the results obtained in previous studies [30,31,32]. The result is consistent with those described above, and it is typical for people with professional experience and high activity after completion of the competition period.

The topic discussed in this paper was also preparation for the start in a marathon. The presented data on the annual load were intended to show the level of training activity. The examined person had a competitive past, high activity aimed at shaping endurance after the competition period and high endurance. In the study, 11 DSP loads were analysed before the marathon. The DSP volume range ranged from 712 km to 346.5 km (average of 563.9 km in the DSP). The weekly mean volume was about 70 km per week (SD 12.3). Comparing the weekly time devoted to physical activity, it was found that in the DSP, it was greater by approx. 100 minutes (328 minutes). This proves the increase in volume during preparation for the start in a marathon. The presented activity in preparation for the marathon resulted in relative stabilisation of performance level between 2:48 and 2:57 (apart from the first marathon) in the results. Taking the age of the participant and the period considered into account, this should be considered a great success. The results of the correlation between training measures carried out in the DSP and the outcome of the marathon are interesting. This evaluation demonstrated a strong correlation between the volume and the measures from the supra-threshold group. As for the first dependence, it does not raise any doubts, while the strong correlation between the supra-threshold measures and the result seems to be of interest. This is perhaps due to the tendency towards intensifying the training of middle-aged runners, and even more so among former runners. The increased intensification of training may be influenced by the number of training units per week which, in most reports, ranges between 3 and 5 (similar to the examined person), which extends the recovery period between training stimuli [33].

Another aspect considered in the study concerned the tactics of the run and the estimation of the result on the basis of the test performed in the week preceding the start. As suggested in the work by Mirek et al. [16], 100% of the threshold speed can be maintained for approx. 150 minutes. Based on these data and other studies [34-37], a high diagnostic value of this test was found. Its correlation between the speed of the marathon run and that for the threshold was found at the level of $r=0.97$. It was also noted that the difference between the threshold and average speeds for the marathon is small, i.e. from 1% to 3% depending on the time in the marathon. Smaller differences were found between run-

ners achieving less than 3 hours in the marathon. In the presented study, the average difference between the threshold speeds in 8 tests and the results in the marathon run was 3.1%.

Of course, the marathon result also depends on environmental factors that are not taken into account in the tests.

In our research, we confirmed the significant role of training in obtaining a relatively stable and high result level in a marathon run. The role of systematic training in the body's adaptive response is also emphasized.

Conclusions

1. The presented values of training activity allowed to maintain a high level of VO2max and the rate of its decline totalling 4.2% per decade.
2. A high correlation was found between the annual volume and the measures from the supra-threshold group in DSP and the result in the marathon run.
3. The authors' own research allowed to confirm the high diagnostic effectiveness of the progressive test in estimating the result for a marathon run.

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