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CASE STUDY

IMPORTANCE OF BASIC ENDURANCE IN TRIATHLON AT YOUTH AGE

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Summary

The study describes the annual training of an international level youth female triathlete who participated in the 2024 European Youth Championships. The aim of the study was to present the distribution of training volume by intensity, sub-sport and time. Training sessions were divided into three intensity zones. The first zone was below the individual anaerobic threshold (IAT), as determined by the Dickuth method. The second intensity zone was between the IAT and the onset of blood lactate accumulation (OBLA), the third zone was above the OBLA. During the 49 weeks, the athlete trained a total of 568.7 hours, which is 11.6±3.7 hours/week (mean ± standard deviation). The training volume for swimming, cycling and running was 203 hours (4.1±1.9 hours/week), 175.8 hours (3.6±2 hours/week) and 149.2 hours (3±1.2 hours/week). 40.3 hours (0.8±0.9 hours/week) were spent on strength training and practicing transitions. In total, swimming, cycling and running training took 463.7 hours (9.5±3.2), 45.6 hours (0.9±0.6) and 19.0 hours (0.4±0.3) in the three intensity zones. The athlete has improved her time and/or ranking in all competitions in which she participated during the previous season. It can be shown that improvements in race results are achievable at youth age with a basic endurance training focus.

Keywords: endurance training, physical education and training, lactic acid, running, physiology

Introduction

In triathlon, swimming, cycling and running must be completed consecutively without interruption over different distances. To compete effectively, a large amount of training is required to achieve an adequate level of fitness in all three sports [1]. A number of physiological variables have been identified in the scientific literature as having a positive effect on successful performance in a given sport. In endurance sports, three main factors – maximum oxygen consumption, lactate threshold and efficiency (i.e. the cost of oxygen to produce running speed or cycling power) - play a key role in performance [2].

The proportion of training time and rest, possible injuries and illnesses, and the extent of training required, all influence the coach's decisions on individual preparation for training and competitions. In many cases, the best source of individual training optimalization is the athlete's subjective feedback [3].

Systematic observation of athletes, anecdotal experience and evidence-based knowledge inform the coach to design an individualized integrated training plan for each athlete.

Intensity of training in different sports needs to be balanced with a personalized training program, periodization and adequate recovery. In addition to the three sports, it is also necessary to practice transitions between legs and strength training should be done in addition to endurance work, which can help prevent injuries. They also require additional training time from the athlete.

When planning training, the interaction between the three main training factors (training volume, training frequency, intensity) should be taken into account [4,5].

However, there are few studies in the literature on the annual training of youth triathletes [6]. The present case study describes the annual training work of a young athlete between

October 2023 and September 2024. The athlete is an international level youth age female triathlete who participated in the 2024 European Youth Championships.

The aim of the study was to present the distribution of training volume by intensity, sub-sport and time. The author personally planned and conducted training sessions.

Case description

The age of the athlete was 16 years, height 169 cm, weight 53 kg, body fat percentage 17% at the beginning of the season. In 2024, she was twice first and twice second in her age group in the Hungarian ranking competitions, 12th, 27th and 32nd in the Junior European Cups and 26th out of 77 finishers in the European Youth Championships.

Material and methods

The workouts performed were divided into three intensity zones. The first intensity zone was the intensity below the individual anaerobic threshold (IAT) established by the Dickhuth method [7], which usually means lactate production below 2 to 2.5 mmol/l. The second zone was the intensity between the individual anaerobic threshold and the onset of blood lactate accumulation (OBLA), characterized by lactate concentrations between 2.5 and 4 mmol/l. In the third zone, exercise intensity above OBLA was classified.

In everyday practice, the intensity zones obtained during the measurements were updated with the athlete's feedback. The results of the laboratory measurements were checked with track tests and control measurements during training, and corrected with new measurements, if necessary (Figure 1). Swimming training was controlled by swimming the given distance in the given time, cycling training by heart rate readings, and running training by heart rate readings and/or by completing the given distance in the given time.

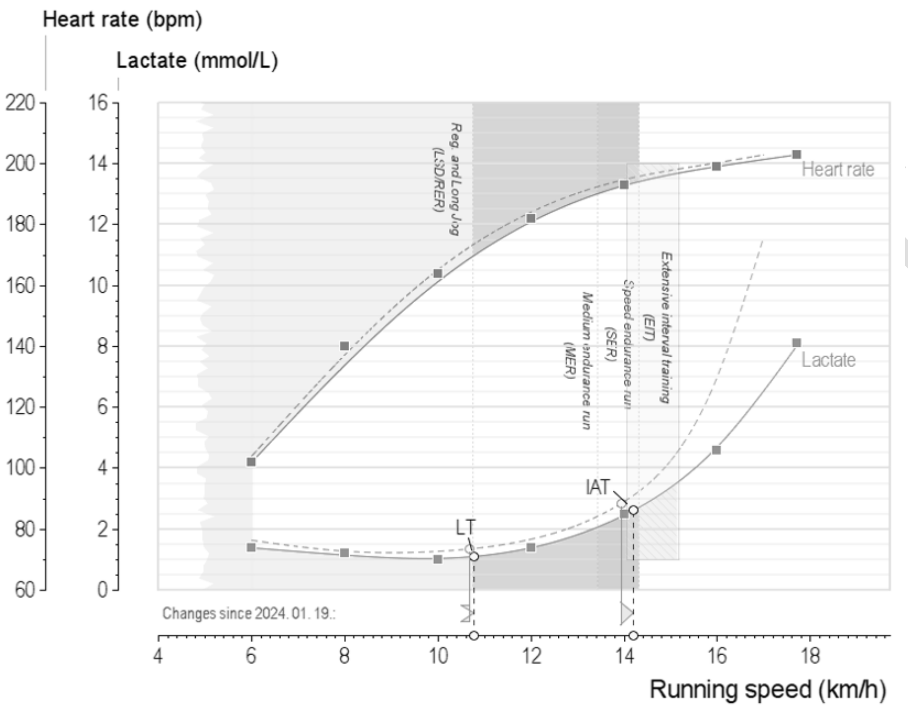

Figure 1. Example for a corrected new measurement (e.g. treadmill, 2 km/h increment, 3 min step duration)

Notes: An improvement in the IAT performance was detected in the repeated treadmill lactate step test. A fixed increase of 1 mmol/l lactate from the first lactate elevation point (LT) occurred later at higher running speed.

Case analysis

During the 49 weeks studied, the athlete trained for a total of 568.7 hours, or 11.6±3.7 hours/week (mean ± standard deviation), of which 203 hours (4.1±1.9 hours/week), 175.8 hours (3.6±2 hours/week) and 149.2 hours (3±1.2 hours/week) were spent swimming, cycling and running, respectively. In addition, 40.3 hours (0.8±0.9 hours/week) were spent on strength training and practicing transition. Taking into account the training of the three sub-sport disciplines (swimming, cycling and running), she spent 463.7 hours (9.5±3.2), 45.6 hours (0.9±0.6) and 19.0 hours (0.4±0.3) in the three intensity zones.

The distribution of the training volume by discipline in km during the period under study was 630.3 km (12.86±6 km/week) for swimming, 5225.2 km (106.6±59.8 km/week) for cycling and 1635.17 km (33.37±13 km/week) for running. In terms of training sessions, it meant that of the total 608 sessions (12.4±3.7 sessions/week) completed, swimming accounted for 196 (4±1.7 sessions/week), cycling for 143 (2.92±1.3 sessions/week), running for 206 (4.2±1.5 sessions/week) and other sessions for 62 (1.27±1.27 sessions/week).

Interestingly, the “average” length of the athlete's training sessions during the period under study were swimming (3.2 km; 1.04 hours), cycling (36.5 km; 1.23 hours) and running (7.9 km; 0.73 hours). They were of course varied according to the different stages of training.

Figure 2 shows that swimming accounted for most of the volume in the early autumn and winter. From week 24 onwards, cycling took over the leading role. It was justified by the opportunities provided by the continental climate, as it was already April. The shift was reinforced with a cycling-centric training camp in weeks 26-27. Running was the third in the quantitative order for most of the year. The ratios reflect aware coaching decisions.

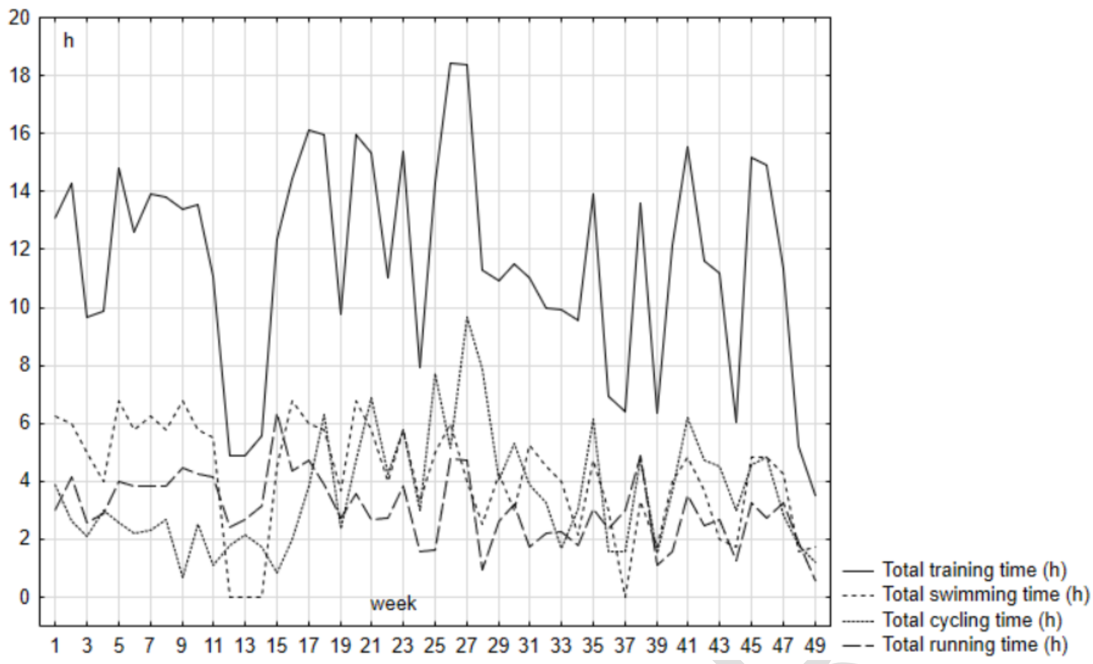

Figure 2. Performed total training time (h) in the examined period

Notes: The figure shows the distribution of training volume (h) by sports over the 49 weeks.

However, there were also factors that had an unforeseen impact on the work. They included the swimming pool being closed between weeks 12 and 14 and, in addition, a cyclist crash at the end of week 36, which had a major impact on the start of the racing season. Here too, the amount of swimming was reduced to zero for a week, and the total amount of training was also reduced.

Figure 3 shows the distribution of the weekly training volume in the three intensity zones. The dominance of zone one is clearly visible throughout the season. For most of the year, we worked in the so-called pyramid scheme, i.e. zone three was the zone in which the athlete spent the least time training [8].

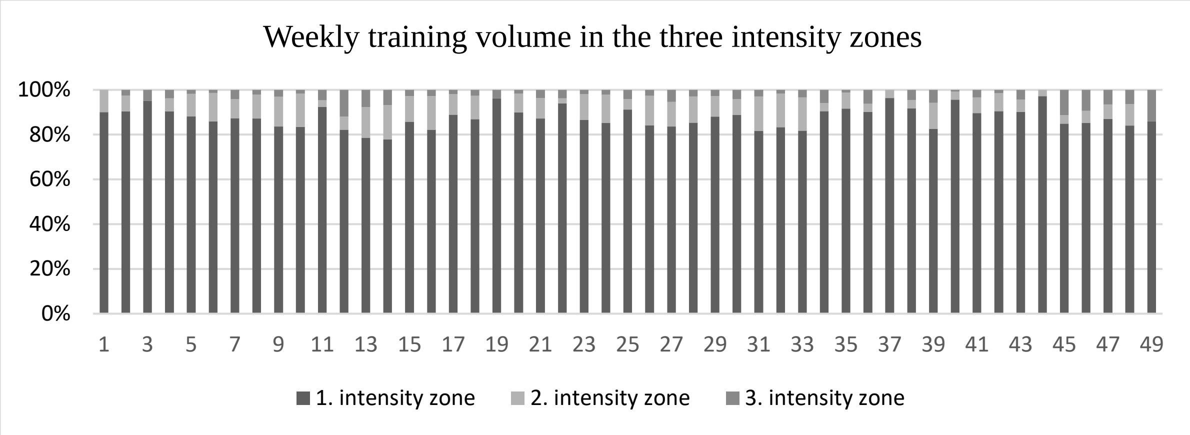

Figure 3. Weekly training volume in the three intensity zones

Notes: The first intensity zone is below the IAT, the second zone is between the IAT and the OBLA, and the third zone is above the OBLA.

It can be seen, however, that in the month prior to the European Championships (from week 45 onwards) we deviated from it towards a polarized model [9] for the expected improvement in race performance, as the shift from a pyramidal to a polarized distribution maximized the performance gains [10].

Figure 4 gives a more visual representation of the variation in time spent in each zone over the season. During the spring training camp mentioned above, the time spent on the higher intensity training sessions in zone three increased, but it was no different from the previous system, as the total amount of training increased, including the time spent on the other two zones. In the period before the main competition, however, the change of concept in the training program was clearly visible. Here, the priority was no longer to maintain the basic endurance level, but rather to exercise at an intensity close to the maximum oxygen uptake capacity. The reasons for it were the high importance of the race, the imminent end of the season and the shorter distance typical of the Youth European Championships.

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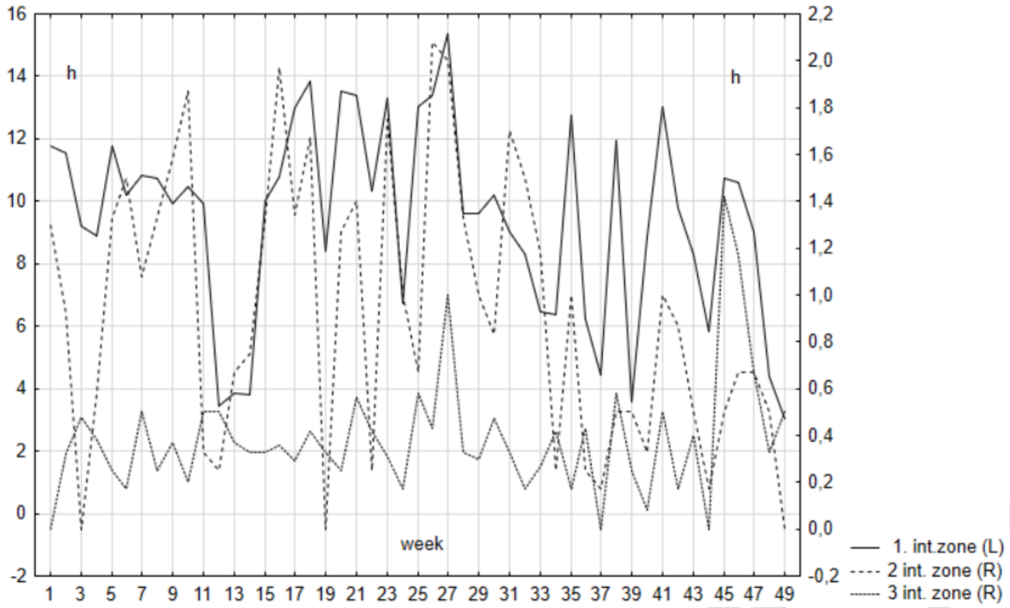

Figure 4 Time spent in intensity zones during the period under study

Notes: The figure shows the distribution of the training performed in three intensity zones, proportionally.

Table 1 clearly shows that in each of the races she improved her ranking from the previous year and in four out of six of the races she improved her finishing time.

Table 1. The athlete's time scores and placings in the under-examined period (2023-2024)

Races	Finish time 2023	Ranked 2023	Finish time 2024	Ranked 2024
Race 1	1:04:01	9.	1:06:54	4.
Race 2	1:06:13	7.	1:05:29	2.
Race 3	0:40:50	37.	0:44:10	27.
Race 4	0:37:52	3.	0:36:05	1.
Race 5	1:03:50	4.	1:02:54	1.
Race 6	1:07:00	7.	1:02:57	1.

Notes: The table shows the finish time (hh:mm:ss) and the final position of the athlete in competitions in which the athlete participated in both 2023 and 2024.

Conclusions

81.5% of all the athlete's swimming, cycling and running training during the study period took place in the first zone, which is the basic endurance development zone. At the same time, the athlete has improved her ranking and/or time result from the previous year in all races during the 2024 triathlon season in which she participated in the previous season. Her results also earned for her a place in the Hungarian national junior team. It is therefore safe to say that improvements in race results can be achieved at a young age with a focus on basic endurance training.

Recommendations for further training

Athletes spent most of their training time swimming (35.7%), cycling (30.9%) and running (26.2%). These proportions were explained by the young age of the athlete and the low injury risk of swimming. However, in triathlon competitions, cycling is the activity that athletes spend most of their time on. Cycling also plays a key role in the condition in which the athlete arrives for the all-important run. With advancing age and the increasing importance of international competitions, the importance of cycling and running should be reflected in the quantitative indicators of training.

Disclosures and acknowledgements

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The trial was performed in compliance with the guidelines and policies of the Health Science Council, the Hungarian Scientific and Research Ethics Committee (IV / 3067-3 / 2022 / EKU), and the Declaration of Helsinki.

Artificial intelligence (AI) was not used in the creation of the manuscript.

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