

Negative Training Responses During the Runners' Career Could Cooperate in an Early Career Termination: A Case Study in Top-Level Female Runners from the Slovakian National Team

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ABSTRACT

Purpose: The early career drop-out in professional youth athletes is a complex and multi factors process and seems to be more common in individual sports with higher physical demands, such as running disciplines. The present study, therefore, investigated the training responses during the career of top-level female runners who terminated it early. **Methods:** Data from four female runners (aged from 22 to 24 years) from the Slovakian national team in running disciplines who have ended their careers early were collected. A semi-structured interview was performed to explore multiple factors (e.g., athletic career, training routine, training camps, racing, performance, recovery, nutrition sleep, health, motivation, psychological responses, relationship with coach, parents and friends, financial support, present status, and future plans) and by questionnaires about wellness, motivation, mental exhaustion and low energy availability. **Results:** The interview shows that the most common factors reported by the former runners were: early specialization, inadequate training dose-response (e.g., high intensity and insufficient recovery), pathological nutritional behaviour, health problems, psychological factors, and loss of motivation. The factors reported during the interview were associated with negative results of the wellness questionnaire (score 10 ± 1.9) and low energy availability (score 12 ± 2.9). **Conclusion:** The study highlights the negative training responses during the runners' career and it could trigger an early career termination. Based on the athletes' reports, was possible to notice that the early sports specialization in running disciplines affected negatively their health, nutrition and psychological aspects, and could be due to higher training loads and insufficient recovery. Caution should be taken by coaches and professionals involved during the sports specialization, in order to minimize the negative impact of training routines on youth athletes and consequently avoid an early drop-out.

Keywords: early specialization, overtraining syndrome, female and male athletic triads, relative energy deficiency, disorders eating, athletes

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INTRODUCTION

The early drop-out in professional youth athletes is a complex and multi factors process and seems to be more common in early sport specialization periods and in individual sports with higher physical demands, such as the running disciplines. Sports such as running are usually characterized by an intense training routine in order to optimize the athlete’s performance (Striano and Purcell, 2006), and when this training is performed by youth athletes, can generate maladaptive responses in case of inappropriate training doses and insufficient response. The literature has described that an early specialization increased the athletes’ chance of overtraining and overuse injuries triggered by a combination of high intensity and insufficient recovery, and this combination can trigger an early dropout due to physical and emotional burnout (Di Fiori et al., 2014; Valovich-McLeod et al., 2011).

Youth female athletes have been considered a population more sensitive to present health issues related to training maladaptation, inadequate energy consumption and eating behavior (Sharps et al., 2022). To address these health issues, the International Olympic Committee attributes the concept of Relative Energy Deficiency (RED-S), what was known as the female athlete triad (Reardon et al., 2019), caused by chronically poor energy availability and nutrition (Stellingwerff et al., 2021). The presence of low energy availability in youth female athletes can result in a delay of puberty, menstrual irregularities, development of harmful eating behaviors, stress fractures, loss of muscle mass and impaired physical capacity (Desbrow et al., 2019; Areta et al., 2021).

The interrelationship among poor energy availability, overtraining syndrome, impairment of emotions, and mental exhaustion can altogether provoke an early career termination. Taken together, considering that youth female is a risk population of poor health and the running sport modality is a high-demand sport, understanding the outcomes generated during the process of the running specialization period can help to identify possible variables responsible for early career termination in this specific population. The present study, therefore, investigated the training responses and the possible association with low energy availability, emotional responses and mental health during the career of top-level runners from the Slovakian national team who terminated it early.

METHODS

Participants

Data from four elite athletes (22–24 years old), who started and finished early their careers in top-level athletics were collected. The athletes competed in short, medium and long distances races, and represented the Slovak Republic. The inclusion criteria were to be a member of a youth athletics team before retirement and participation in at least one top competition in the youth

category, such as the World Championship, European Championship, or competitions organized by the International Olympic Committee (YOG, EYOF). Before starting, the runners were informed about the aim of the study and consented to participation.

Experimental design

The athletes were selected intentionally, based on the inclusion criteria. The study utilized qualitative and quantitative approaches. Qualitative research based on expert interviews is widely used as a method across multiple disciplines including sports science. Quality interviewing is often aimed at obtaining information or studying a particular field activity. Some studies in the field of sports science need to measure behavioral perspectives, such as athletes' motivation, attitudes, beliefs, and perceptions. These factors are difficult to measure without using qualitative research methods such as interviews. Qualitative methods are also useful in the study of contextual factors that affect athletic performance (Draper, 2009), thus, in the present study, the runners are the key informants who have specific knowledge and skills, and they are used as a source of information. Interview questions have been designed to explore the female runners' training during their youthfulness with open-ended questions to understand the key factors perceived by athletes to finish early their careers at the top level. The interview script was separated into two parts: the first part the questions related to their experience during the training period obtained by semi-structured questions and in the second part the questions were based on questionnaires about wellness, motivation, mental exhaustion and low energy availability.

Interview procedure

The interviews were standardized by using a semi-structured script in order to minimize possible bias. The questions were developed by two researchers: one former female runner and one researcher with previous experience in training demands in professional athletes. All four interviews were conducted by one researcher, who has previous contact with the athletes, which allowed her to guide the interview using specific terminology associated with the topic and generate a relaxing environment with the interviewees.

The procedure of interview occurred via an online phone call lasting approximately 2 hours, with each respondent separately. In the first part of the interview, semi-structured questions were asked. It was 28 open questions with 53 additional sub-questions in the thematic areas: athletic career, training routine, training camps, racing, performance, recovery, nutrition sleep, health, motivation, psychological responses, relationship with coach, parents and friends, financial support, present status, and future plans. The interviewer guided the respondents in order to go back in time and answer all the questions. In the second part of the interview, it was asked established questions based on questionnaires, in which they point out their training dose and response liked to wellness, motivation, mental exhaustion and low energy availability.

Questionnaires

To obtain information about wellness, motivation, mental exhaustion and low energy availability, it was chosen questionnaires already used in sport science literature, with an easy approach but relevant outcomes. The questions were made based on the runners' past experience during their career as top-level athlete representing the Slovakian national team.

Wellness Questionnaire: the wellness questionnaire gathers ratings of perceived muscle soreness, general well-being, fatigue, stress and sleep on a scale from 1 (very poor response) to 5 (very good responses). This instrument has been used widely in sports settings in different sports disciplines to monitor athletes' responses to training demands and used recently for the authors (Silva et al., 2022; Bernaciková et al., 2022). For this study, the questionnaire was used retrospectively to find out the level of fatigue in the runners during the period in which they began to suffer from stagnation or even a decrease in performance and overtraining status. The results were interpreted as follows: a total answer score of 4–8 indicates severe fatigue; 9–15 indicates moderate fatigue and a score of 16 or more indicates that the athlete is doing well and can continue training without restrictions (McGuigan, 2017).

Motivation Questionnaire and mental exhaustion questionnaires. The questions about motivation and mental exhaustion were built by previous studies of a sport psychologist (Květon et al., 2020; Burešová et al., 2021) and used recently in a mobile application to prevent chronic fatigue (Bernaciková et al., 2022) (see Supplemental Material). For the perception of mental exhaustion, it was asked 'how mentally exhausted do you feel during the training period? Twenty-three questions comprise this domain, with Yes or No options given. The total scores from 0–5 affirmative answers indicate that the training process was completely fine; 5–15 affirmative answers reveal a certain degree of psychological exhaustion; 15 or more positive answers warn of a high risk of psychological exhaustion, which could result in a decrease in performance. For the motivation domain, the focus was to find out how the respondents were motivated when they were thinking about ending their careers. Twenty-two questions were asked with 6 questions considered a high risk of loss of motivation; 10 questions a medium risk and 6 questions as low risk. If the respondent answers YES 5 times out of 6 low-risk questions, it means that she was highly motivated to continue her training. If an outcome was YES to 5 high-risk questions, the result indicates a loss of motivation. In this situation, it is obvious that the athlete was not so motivated, probably frustrated and the sport no longer fulfilled her. For all other resulting combinations, we identified incipient motivation problems.

Low Energy Availability Questionnaire (LEAF-Q). The LEAF-Q is a 25-item questionnaire used to screen physiological symptoms associated with female athlete triad and relative energy deficiency (Melin et al., 2014). The questionnaire considers three domains: gastrointestinal function, injuries and menstrual function. For the purpose of determining the possible occurrence of these irregularities, the questionnaire was also used in our research. A score ≥ 8 indicates a risk of low energy availability and female Triad. The LEAF-Q is validated in female athletes (aged 18–39), involved in ≥ 5 times/week training, reporting an adequate sensitivity (78 %) and specificity (90 %) (Melin et al., 2014).

Data analysis

Data from interviews were analyzed following the process of data engagement, coding and theme development (Braun and Clarke, 2021) as follows: i) data familiarization (reading and rereading the transcriptions of interviews); ii) systematic data coding (coding the whole texts and identify the part of the texts which are answering the research questions); iii) generating initial themes from

coded and collated data (combined the data into the main themes); iv) developing and reviewing themes (detailed analysis of the themes); v) refining, defining and naming themes (name, split, combined, or discarded themes, confirming if research questions were answered); and vi) writing the report. The transcription was made by the same researcher who performed the interviews and revised by a second researcher. After analyzing the verbal reports, the researchers together determined the words and phrases for each category of questions. The data from the questionnaires were calculated and described according to the established classification.

RESULTS

The results are briefly categorized and summed up in tables. Table 1 presents the runner's training characteristics. It was possible to observe a higher training volume (up to 20 hours per week) and poor active recovery (1 – 3x/week).

Table 1 Characteristic about training and races in runners

	Athlete 1	Athlete 2	Athlete 3	Athlete 4
Discipline/ best record	800 m: 2:12.07 min	100 m: 12.0 s 200 m: 24.68 s	800 m: 2:16.36 min 1500 m: 4:40.45 min	100 m: 12.18 s 200 m: 24.83 s
Training duration (min)	90	90	90–120	90–120
Training frequency (week)	8–10	8–10	8–10	10
Training volume (h/week)	12–15	12–15	14–20	15–20
Training intensity RPE (6–20)	15–20	11–20	15–19	14–20
Training camps (per year)	6	3	3	4
Races (per year)	38	40	27	40
Active recovery (per week)	1	1	1	3

Note: RPE= rating of perceived effort.

Complementary, it was asked during the interview about the strategies used by the runners to recover after training. The most common answers were massage, sauna and whirlpool. Two runners mention swimming and one runner mentions banking

Table 2 was created based on the synthesis of the open questions and the questions from the questionnaires. The outcomes were displayed in the categorical description, in order to present factors that can help better understand the runners' performance and behavior during the career that could affect the early termination. The results indicate a high risk of pathological conditions such as overtraining syndrome (OTS) and female athletic triad (FAT). An interesting point was that the runners presented adequate sleep, not disturbance and the length was usually 8.5 hours. The close questions gave the information that, besides the athletes sleeping soundly, they did not feel rested in the morning.

Table 2. Performance and behavior during the runner's career

	Athlete 1	Athlete 2	Athlete 3	Athlete 4
Training volume	high	high	high	high
Performance testing	low	low	regularly	low
Recovery	insufficient	sufficient	insufficient	insufficient
Nutrition	insufficient	insufficient	insufficient	sufficient
Disorders eating	yes	no	yes	no
Energy for training	low	medium	low	low
Training diary (monitoring)	yes	yes	yes	no
Peak of performance (years)	16 yrs.	17 yrs.	15 yrs.	16 yrs.
Performance stagnation	no	yes	yes	yes
Performance drop	yes (16 yrs.)	yes (18 yrs.)	yes (16 yrs.)	yes (16 yrs.)
Overtraining	high risk	increased risk	increased risk	high risk
Injuries	often	minimal	often	often
Burnout syndrome	high risk	high risk	increased risk	low risk
FAT	high risk	high risk	high risk	high risk
Changes in training	no	yes	no	no

Note: FAT= Female Athletic Triad.

Table 3 describes the outcomes of the wellness and low energy availability (LEAF-Q) questionnaires. All female athletes showed high risk in the LEAF-Q.

Table 3. Classification of wellness and low energy availability questionnaire

	Athlete 1	Athlete 2	Athlete 3	Athlete 4
Sleep quality	good	very good	very good	good
Muscle soreness	high	average	very sore	high
Stress level	high	high	average	average
Fatigue level	very fatigued	low	very fatigued	very fatigued
Total Score	9	14	10	10
LEAF-Q (score)	high risk (14 points)	high risk (10 points)	high risk (17 points)	high risk (10 points)

Note: LEAF-Q = Low Energy Availability in Females Questionnaire.

The Table 4 summarize the finding of the questionnaires, asked in the second part of the interview. The main outcomes assumed an incidence of symptoms of pathological conditions, which are increased level of fatigue, decreased level of motivation, increased level of psychological exhaustion and low energy sufficiency in sports.

Table 4. Results of the questionnaire survey of female respondents

Questionnaire	Athlete 1	Athlete 2	Athlete 3	Athlete 4
Wellness	↑ fatigue	↑ fatigue	↑ fatigue	↑ fatigue
Motivation	↓ motivation	↓ motivation	↓ motivation	↑ motivation
Mental exhaustion	↑ exhausting	↑ exhausting	↓ exhausting	↑ exhausting
LEAF-Q	↑ triad risk	↑ triad risk	↑ triad risk	↑ triad risk

Note: LEAF-Q = Low Energy Availability in Females Questionnaire.

In Figure 1, based on the combination of data from the interview, summarized and conceptualized the most common factors that could affect the early career termination of top-level female runners.

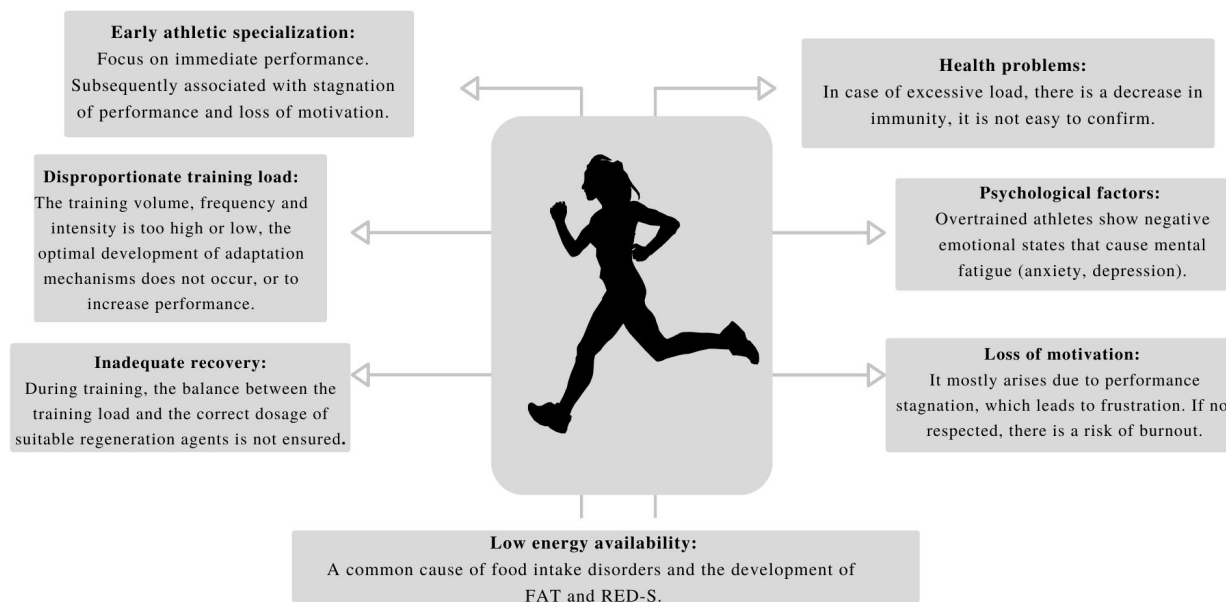


Figure 1. Sum up of factors observed during the career of top-level runners with early career termination

DISCUSSION

The main aim of the study was to investigate the training responses in top-level female runners who terminated their careers early. The main findings show that the most common career factors of the former runners were: early specialization, inadequate training dose-response (e.g., high intensity and insufficient recovery), pathological nutritional behavior, health problems, psychological factors and loss of motivation. The factors reported during the interview were associated with negative results of the wellness questionnaire (score 10 ± 1.9) and low energy availability (score 12 ± 2.9).

Based on the runners' answers, it was possible to notice that they were overloaded. The training intensity was long-term high, as 3 out of 4 athletes reported an effort scale of 20 during the training period, which should not occur in a normal training process. This limit is referred to as

the maximum strain caused by maximally intensive interval training, which places high demands on the athlete's body leading to the development of pathological conditions. Therefore, in order to determine the optimal training intensity, regular monitoring of performance by physical tests and the monitoring of the wellness state is recommended (Bird, 2011). Only 1 out of 4 female athletes was enrolled in regular performance evaluation. In addition to excessive training intensity, the athletes also completed a high number of training units (or high training volume) – 10 TJ/week, which means 3-4x two-phase training per week.

Regarding the recovery process, it can be seen that the balance between training load and regeneration did not occur between them, which could lead to an emerging non-functional overreaching and overtraining syndrome (McFarland et al., 2014). The struggle with insufficient regeneration reported by 3 out of 4 runners was also indicated by the frequent occurrence of injuries with repetitive nature and a long recovery time from it, which often limited them in return to the training process. It was previously described that the exhaustion perceived by female athletes could also have been caused by low energy availability, which is one of the most frequent causes of fatigue in athletes (Melin et al., 2019, Loucks et al., 2011). In 3 out of 4 runners it was found a long-term low energy intake and 2 athletes previously suffered from disorders eating, which were most likely caused by pressure from the athletic environment. The LEAF-Q questionnaire gives the information that the runners were at high risk of the female athletic triad, scoring a total point higher than 8. Monitoring the sports performance and state of wellness (as part of the prevention of pathological conditions) was lacking or insufficient in the runners. Even though 3 out of 4 athletes regularly kept a training diary, the monitoring process was never performed by the trainer /coach. Possibly, if the recorded data were shared, the coach could adjust the athlete's training load and recommend suitable regeneration in critical periods.

Maximum performance was reached at youth age, approximately around 16 years, and interestingly, at the same age, after achieved the peak, the runners reported experiencing a premature decline in their performance. Previous studies demonstrated that optimal peak performance in athletic disciplines is around 21–23 years for female sprinters and 24–26 years for middle and long-distance runners (Perič, Březina 2019), this information pointed out that the runners from the present study have reached their maximum peak earlier than recommended, which means an ending their promising athletic careers prematurely, even before the onset of the recommended peak age. As speculation, the early athletic specialization mainly contributed to this early career termination. It is possible that the athletes could not handle the pressure that was put on them when their surroundings assumed that their performances would grow further up.

For each runner, was recorded some symptoms of fatigue using the wellness questionnaire, together with mental exhaustion and motivation questionnaires. Compelling the results, it was possible to notice a high score of psychological exhaustion in 3 out of 4 female runners, probably arising from an unreasonable training load or the influence of the surrounding climate (e.g., environmental pressure, coach, relationships), which probably had a negative impact on their performance. In the same way, the motivation questionnaire supported that 3 out of 4 female athletes presented a loss of motivation to continue their sports career and frustration from failures and injuries. When a loss of motivation is detected, it is suggested to remove the causes of its occurrence and restore the athlete's motivation.

Unfortunately, in the case of the present runners, it is speculated that the loss of motivation was not sufficiently addressed and lasted too long, which probably led to the development of burnout syndrome. From this perspective, the impairment in the emotional state could increase the chance of a decision of ending their running career. Moreover, the interview responses showed that the coaches motivated and psychologically supported the runners throughout their careers, however, no changes were made in their training routines, failing to recommend changes in the area of nutrition and disorders eating, recovery and performance evaluation.

Practical recommendations

Overtraining, exhaustion, disorders eating, athletic triad, energy deficiency and burnout syndrome are generally recognized problems that commonly affect both performance and professionalism. It could be confirmed in the present study of female runners. As part of prevention, the authors recommend regular monitoring of training load and physical and psychological responses. At the first sign of an imbalance of training dose-response, an intervention should be performed in order to optimize the training load to avoid pathological conditions such as overtraining and female athlete triad syndromes. Special attention should be paid to performance stagnation and psychological changes which could be caused by the influence of the external environment and occurs before changes in physiological functions (Pernica et al., 2019).

Since psychological fluctuations are common in athletes from athletics modalities, the authors recommend also monitoring the psychological state in order to prevent the development of any pathological condition of the athlete. The questionnaires used in the present study (see Supplemental Material), could be used as a tool for long-term monitoring of the psychological components. Additionally, the LEAF-Q questionnaire could also guarantee early symptoms and help in the subsequent treatment of FAT and RED-S manifestations. A 24-hour recall or various measurements of body composition (e.g., InBody, bone densitometry, BOD POD) also have great validity in the prevention of these conditions (Łuszczki et al., 2021). The wellness questionnaire, which indicates the degree of fatigue, appears to be a very easy and informative tool to use in a practical context and can help in the prediction of the possible overtraining status in athletes. Another and perhaps the most important preventive measure for early retirement in athletics is the selection of a competent coach. The coach plays a key role in the development of athletes' performance and long-term careers, so an inability to plan an adequate training dose-response could lead to a harmful process triggering an early career termination. This topic was addressed by the respondents themselves, who state that they did not have enough competent and educated trainers in their area. In this matter, the authors emphasize the necessity of focusing on improving the education of athletics coaches, not only in the field of training load management but also in the field of sport psychology.

CONCLUSION.

The study highlights the harmful training responses during the runners' careers and it could trigger an early career termination. Based on the athletes' reports, was possible to notice that the early sports specialization in running disciplines affected negatively their health, nutrition and

psychological aspects, and could be due to higher training loads and insufficient recovery. Caution should be taken by coaches and professionals involved during the sports specialization, in order to minimize the negative impact of training routines on youth athletes and consequently avoid an early drop-out.

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