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UNIQUE ANNUAL PHYSICAL TRAINING PLAN FOR 45+ FEMALE MASTER HALF-MARATHON RUNNERS

SUMMARY

Doctoral field: Science of Sport and Physical Education

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The topic addressed in the doctoral thesis, the unique annual plan for the physical training of 45+ female master runners for the half-marathon race, belongs to the field Science of Sport and Physical Education. The actual content of the summary is preceded by an introduction that argues the choice of the topic and which presents its contemporary relevance in the context of scientific studies and in the general social context of concerns regarding the improvement and maintenance of the health of the population, doubled by personal motivations. The introduction then sets out the structure of the thesis, summarizing the content of the ten chapters.

INTRODUCTION

Contemporary relevance and importance of the topic

Outdoor exercise has become a popular activity worldwide, being associated with health benefits and slower aging, a subjective wellbeing and a high quality of life. Numerous works highlight the benefits of physical activity and the negative effects of sedentary life on health (WHO, 2022). A positive attitude towards physical activity leads many people, men and women, professional and amateur runners, young and old, to train for a half-marathon. The importance of health is increasingly emphasized in a world where the average life expectancy is increasing, but one in four adults does not comply with global recommendations regarding the level of daily and weekly physical activity (WHO, 2022). The study of master athletes provides information on their ability to maintain good body function and high physical performance even at old age, endurance runners being considered among the healthiest people (Tanaka & Seals, 2008; Day & Thompson, 2010).

The attractiveness of the half-marathon is visible in the large number of amateur runners and the increasing participation of women in such sports events, as shown by studies from Switzerland, the USA, Norway, but also from other countries. Nowadays, the typical half-marathon runners are no longer men, as the group of female runners is expanding worldwide. In Romania, although the half-marathon was later established as a sports branch, the trends are converging with those worldwide, but, for now, female athletes participate less in such races compared to other countries. The website of the Romanian Athletics Federation informs us that at the Bucharest Half-Marathon, the number of participants has gradually increased since 2016, simultaneously with the constant increase in the number of women. At the Cluj-Napoca Half-Marathon, from 2016 until 2022, the number of participating female athletes has increased constantly, in 2022 representing 29.06%.

The heterogeneous profile of the half-marathon runner in terms of age and gender has led to the diversification of training models to meet the variety of anatomical and physiological or psycho-social factors that influence the performance and wellbeing of endurance runners, amateur or professional. Amateur athletes often have running experience, but many, unassisted by a coach, exceed their upper limit of training, experiencing overtraining (Predel, 2014), absence of physiological adjustment (Bompa & Haff, 2009), or deterioration of previous fitness (Mujika & Padilla, 2000). Amateur athletes are also disadvantaged in terms of scientific studies, where factors related to performance and prediction of finishing times are less often addressed in this group (Vickers & Vertosick, 2016).

Although the half-marathon has become popular, there is no consensus on the best training practices to improve physical performance in a healthy way (Boullosa et.al., 2020). Controversies among experts regarding the effectiveness of various training models, as well as the need to adapt them to the

particularities of athletes, complicate the issue of the optimal type of training for a category or a person. In addition, the management of training in amateur athletes is more difficult due to family and professional obligations that require a balance with said physical activity.

In this context, the main purpose of our research is to develop, substantiated by scientific data, the implementation and monitoring of a training plan for amateur master sportswomen, aged 45+, a group that is increasing numerically in the half-marathon. The doctoral research approach is focused on the following major objectives:

- the development of a training plan for amateur half-marathon sportswomen;
- the implementation of this plan during 12 mesocycles, corresponding to one calendar year;
- monitoring the implementation of this plan through field checks, laboratory tests and analyzing the participants' satisfaction. We started from the assumption that a training plan centred on the physical component of training can help female amateur athletes maintain and, optimally, improve their physical abilities, obtaining high satisfaction in endurance running.

To the best of our knowledge, the proposed and tested training plan is the only one of its kind in Romania which, after improvement, can become a real help for amateur master athletes, since they do not, most frequently, benefit from the support of a coach or other experts. At the same time, the number of training plans for this category of endurance runners is also reduced in the world literature.

Personal motivation

The topic chosen for the doctoral thesis coincides with one of our major concerns in the last decade and half of life. For reasons related to the improvement of my personal physical health, in 2008, I resorted to professional reconversion, enrolling in a physical education and sports faculty, although I had an engineering degree and an attractive job. I started running at the age of 38 and have been able to achieve good performances at local, European and world level, the best result being the national record at the European Masters Road Running Championship in Alicante, Spain, 2018.

When running, I would ask myself many questions, to which I looked for answers in various sources. The doctoral thesis research was designed to find answers regarding training and competitions in endurance running, to assemble them in a coherent form. In this context, we consider that our personal concern meets the concerns of other athletes or other people who have not yet started running and simultaneously responds to some major social objectives.

Structure of the thesis

The doctoral thesis is organized in three coherent parts, arranged in the following order: theoretical-methodological substantiation of the topic, preliminary research and basic research. The first part, consisting of four chapters, provides a narrative presentation of the relevant studies on the topic addressed, obtained from books, textbooks in the field, encyclopedias and, above all, articles recently published in magazines or presented at scientific events. The preliminary research describes two studies carried out by us on Romanian athletes participating in the half-marathon. It begins with the presentation of the premises and continues with the research design, common to the two ascertaining studies. The hypotheses, research questions, results and their discussion, as well as the conclusions and analysis of limitations are described in the 5th and 6th chapters. The following three chapters

comprise the basic research, which responds to the main objective of the thesis: the development, implementation and verification of a unique annual training plan intended for 45+ amateur athletes, participating in the half-marathon. Similar to the preliminary research, this part presents the design, hypotheses, results and associated discussions, with the unique annual training plan as its central element, described in detail. As a whole, the research is mixed, combining quantitative and qualitative research, to which the formative experiment on a single group, with pre-test and post-test, is added.

The first chapter of the thesis introduces us into the issue of the half-marathon, specifying its characteristics and dynamics as a sporting event, the international and national governing bodies, provides information on approved marathons and the evolution of athletes' participation. They establish our option for the target participants of the research, female amateur master athletes, aged 45+. The second chapter addresses the main bio-psychomotor characteristics of endurance athletes, describing, based on the literature in the field, similar features and gender and age differences. The chapter draws out some interesting aspects concerning the negative consequences of aging on sports performance, but also the positive consequences of running a half-marathon on health and aging. Chapter three presents the key concepts of scheduling, organizing, and monitoring half-marathon training that will help us design, implement and monitor the training plan. The fourth chapter focuses on the characterization of fatigue, injury in endurance runners and recovery after exercise. Based on the readings, both the defining features of these processes are presented, as well as gender and age differences, a constant dimension throughout the theoretical substantiation of the work, obviously related to the purpose of our research.

With the fifth chapter we open the preliminary research part, which starts with the summary description of the premises, continues with the organization and methodology of the research, presenting objectives, hypotheses, participants and tools. The qualitative and quantitative results are presented, separately for the two preliminary studies, in chapters six and seven. The data appear in tables and sometimes in charts, in the order of the questions, respectively the hypotheses, being discussed by reference to previous studies and the Romanian context.

Chapter eight is the first in which we explicitly address the basic research, with the same structure as for the preliminary research. In the research design, we mention the main characteristics of the experimental method, in accordance with the proposed objectives and the study participants. Chapter nine describes the independent variable, the unique annual physical training plan of the sportswomen, carried out over 12 mesocycles. The microcycles and training sessions are described in detail so that the experiment can be conducted without difficulty. We made an integrated presentation of the plan description, its implementation and monitoring, through laboratory tests and field checks. The last chapter, the tenth, presents the testing of the seven hypotheses and the interpretation of the results. This chapter presents the average results of the experimental group, but also summarizes the evolution of each participant, presented in individual initial and final boxes. They are similar to case studies and highlight personal characteristics of the athletes, which we consider relevant for the design and evaluation of the unique annual physical training plan.

The thesis ends with the general conclusions, where I reviewed, from a new perspective, the main ideas and results of the research studies, insisting on the new ones, on some original results, but also on the possible research directions in the future. We tried to carry out an objective analysis of the conducted

research, highlighting the main limits that threaten the generalization of the data, the trust in the results. We have listed our articles and scientific events that capitalize part of the thesis results, mentioning the international databases in which they are indexed. The thesis totals 373 pages, and after the 225 bibliographic references and 39 electronic resources accessed, I have inserted the annexes that provide additional information.

PART 1. THEORETICAL – METHODOLOGICAL SUBSTANTIATION OF THE TOPIC

CHAPTER 1. EVOLUTION OF THE HALF-MARATHON AS A SPORTING EVENT

Running is a natural human activity, used as a means of defence, offense or entertainment, which has become a regulated sporting activity. Since 1950, sporting events organizers have sought to offer a more accessible alternative to the standard marathon distance, thus emerging the half-marathon. *The explanatory dictionary of the Romanian language* states that the half-marathon is an athletic test of running over a distance of 21.0975 km (13.1094 miles), half of the distance specific to the marathon. In sporting terms, a half-marathon is a non-stadium (outside the stadium) road, mountain or sand race.

The official competitions for the half-marathon are held as world championships, European championships, Balkan championships, national championships. As part of the World Masters Athletics Championships, the "non-stadium" Masters Half Marathon Championship takes place, a sporting event held under the auspices of the World Masters Athletic (W.M.A.) (Regionkosice.org, 2021). The European Championship is an annual competition, like the Balkan Masters Athletics Championships (2020; EMA, 2020).

The half-marathon has evolved as a sporting event, with the annual number of finalists and races constantly increasing. The participation trends in running events on various distances, including the half-marathon event, indicate a positive course in the number of participants over the last two decades in what concerns the participation of women compared to men. The increase in the half marathon completion time for the two genders is also associated with the age categories and, implicitly, with the variety of physiological and motor characteristics of the participants.

Currently, the half-marathon is practiced in Romania as an annual competition, which takes place within the Bucharest Half Marathon (Bucharest Half Marathon, 2020). The race does not have a strong tradition, as we find in other nations. In this competition, people who have turned 18 have the right to participate, both amateur and professional athletes, registered with a sports club. In our country, in 2022, there were only four approved international half-marathons, which take place in Bucharest, Cluj-Napoca, Braşov and Sibiu. They abide by the procedures, rules, protocols imposed by the Romanian Athletics Federation (FRA), assume responsibilities and require certain conditions of participation, as well as international regulations.

CHAPTER 2. BIO-PSYCHOMOTOR CHARACTERISTICS OF ENDURANCE ATHLETES

Many people who share a passion for endurance running have become increasingly concerned with the biological and psychological "equipment" required for running. Like any physical exercise, running aims to improve the health and physical condition of the athletes, therefore, knowing the functional state of the body is necessary from the perspective of monitoring it. In most sporting activities, the physiological demands are similar for men and women, the training methods applied are most often the same, but the more subtle specific adaptations are less well known, although the morphological gender differences are acknowledged (Juhas, 2011).

The physiological variables such as the maximal oxygen uptake (VO_{2max}), along with changes in lactate levels, are considered the main factors influencing performance in long-distance running. To these, the heart rate, breathing rate, blood pressure, amount of exertion and body temperature are added, vital signs associated with sports performance. Thus, an endurance runner can increase VO_{2max} by up to 25% through sport-specific training, running economy varies by up to 30% among trained runners with similar VO_{2max} , runners with good running economy use less oxygen than runners with a low running economy.

Changes in the level of physiological factors that lead to a decrease in the performance of physical endurance exercises are, for the most part, related to the reduction of the volume of the effort performed and the intensity of the effort in the training sessions. Several studies show that, in general, running performance declines with age, with the decline being more pronounced in women than in men. This may be an explanation for the decline in women's participation in running competitions as they become older (Burtscher et al., 2022). However, some endurance athletes try to conserve energy by improving their running economy through training. If psychomotricity was previously trained, it decreases more slowly with age (Crețu, 2016).

In contrast to the sedentary population, the study of master athletes reveals that they "age gracefully", they can be a model of successful aging and are a source of information regarding the human ability to maintain high physical performance and normal physiological functions (Lepers & Stapley, 2016; Harridge & Lazarus, 2017). Master professional and amateur athletes are considered fascinating models of "exceptionally successful aging," such as Canada's Ed Whitlock, who at 95 became the oldest person to complete a marathon in three hours (Tanaka & Seals, 2008).

Not only exceptions can be arguments for the beneficial effects of physical exercise in the aging process. The results of numerous studies show that people who exercised had healthier hearts and were in better working condition than those who did not exercise (Adlam, 2012). So, we can be active, healthy until old age, through movement. The implicit condition for health is to be physically active, while inactivity has serious negative effects on health, justifying the recommendation that health deserves more attention and less drug treatment (Cucuzzella, 2019). Such results support recommendations to promote moderate to vigorous physical activity at all ages (WHO, 2020).

Personality traits of endurance runners have received less study than anthropometric and physiological characteristics. Adulthood, approximately between 20 and 65 years of age, is characterized as a period of agency, but in middle adulthood (40-65 years of age) major psychosocial changes in lifestyle and personality occur (Papalia, 2010). The psychological profile of endurance

athletes indicated lower scores on emotional tension, depression, anger, fatigue and higher scores on positive mental states compared to the general population (Nikolaidis et al., 2018). In general, athletes are people with good self-control, a high ability to regulate emotions and behaviour (Tedesqui & Young, 2017).

The motivations that drive people to practice running are different, but most of them are related to the fact that practicing this sport offers strong satisfactions (Epuran et al., 2008). Previous studies mention that motivation is related to gender: in men prevail maintaining physical condition and health, developing a passion for endurance running, achieving personal goals; in women, the need for self-evaluation, strong emotions associated with participation in a sports event, the desire to have fun, are dominant. However, the results are inconsistent: for example, female marathon runners in Greece score higher on motivation for self-esteem compared to studies from other countries (Nikolaidis et al., 2019).

CHAPTER 3. CURRENT APPROACHES TO SCHEDULING, ORGANIZING, AND MONITORING HALF-MARATHON TRAINING

Sports training is a long-term activity, carried out through a laborious planning and scheduling process which aims at the rational and sequential organization of training tasks and the recovery process to achieve performance goals (Bompa & Buzzichelli, 2021). Despite the popularity of half-marathon running, there is no consensus on the best effective training practices to ensure the improvement of the physical performance of masters athletes in a healthy way.

Scientific training design and management should focus on key aspects of the training process, such as periodization, training and monitoring methods, performance prediction, running technique, prevention and remediation of health problems associated with endurance running.

Training periodization has been defined as a logical and phasic way to manipulate training variables to increase the possibility of achieving specific performances. In planning the trainings, multiple models are used, with various effects and sometimes opposing followers. The traditional model is a linear model that proposes a progressive, transversal arrangement of cycles/periods/phases centred on (a) physical training (general and specific), (b) competition training (pre-competition and competition) and (c) transition (Matveiev, 1983). The periodization of training is a topic of continuous interest, but in the studied articles we identified few authors who were concerned with the periodization specific to the preparation of amateur endurance athletes for the half-marathon event. In our paper we have presented several concrete training models aimed at athletes, amateurs or professionals, beginners or already trained.

A concept frequently used in describing training plans is effort volume, which represents the total amount of motor activity performed by the athlete, the quantitative prerequisite for high-level technical, tactical and physical achievements (Balint, 2003). In endurance sports, training volume is represented by running distance, whose increase over time is essential for the development of the athlete's aerobic capacity (Bompa & Buzzichelli, 2021). The intensity of the effort represents the amount of mechanical work performed over time, being conditioned by the effort capacity of the person (Balint, 2003) and is generally determined by recording the heart rate and the concentration of

lactic acid in the blood. During training, the levels of exercise intensity increase and an adaptation of the body to cope with the demands of training occurs progressively (Bompa, 2001).

The following section describes and compares athlete training models used by coaches aimed at preparing athletes for competition: aerobic and anaerobic training, interval training, high volume and low intensity training, VO_2 max training, Fartlek training, pyramid and polarized training, cross or alternate training, etc. Many of these tools have been used by us in the annual physical training plan.

Choosing training models is necessarily complemented by monitoring. The two activities are complementary, with monitoring leading to improved training planning and effectiveness. The metrics measured are usually resting heart rate, running heart rate, oxygen consumption, lactate concentration, heart rate recovery after exercise, recovery time, etc.

Training monitoring is carried out, in the case of elite athletes by the coach, but in what concerns amateur athletes who do not have a coach, this monitoring is self-monitoring, which depends on the level of knowledge of the athlete, on his experience of self-monitoring and the ability to manipulate results to improve training. In training monitoring, psychological tools are also used, primarily targeting stress factors, wellbeing, athlete satisfaction or effort perception.

In recent years there has been an exponential growth in the use of electronic sports activity monitoring devices such as mobile apps, GPS watches, activity trackers. They have great potential because they are affordable, have a large area coverage and offer multi-functional use. Among the devices used to monitor running, we mention the Suunto, Huawei, Garmin watches, which we also find in athletes from Romania and which were also used by the female athletes participating in the experiment conducted by us. Monitoring tools should provide relevant, valid information on the training plan and the athletes' progress, be accessible and easy to understand (Lyle, 2002).

CHAPTER 4. FATIGUE, INJURY AND RECOVERY OF ENDURANCE ATHLETES

In sports activity, fatigue is the body's acute, transitory response to physical effort, manifested by a subjective state of discomfort, a temporary decrease in the capacity for effort and alteration of the coordination of the functions of the body. Continuing to move in the face of fatigue is achieved with costly energy consumption. Fatigue in which the body's functional capacity is exceeded is called pathological fatigue, manifested as an acute form (overstrain) and a chronic form (overtraining). By repeating during training the mixed factors represented by effort-fatigue-recovery, the optimal state of the body called overcompensation is reached (Bompa & Haff, 2009).

Fatigue can be associated with injury risk. To prevent injury, firstly, simple measures focused on behavioural changes are important, such as performing lower body strengthening exercises, wearing appropriate training shoes, complying with reasonable training habits (Knobloch et al., 2008).

Recovery is a complex process that leads to the restoration of the capacities necessary to achieve performance (Braun-Trocchio et al., 2022). The recovery of the body after exercise is crucial, but at an older age, the process is less efficient. The importance of recovery methods stems from their association with the improvement of some markers of physical performance. Previous research indicates the presence of the following recovery methods used after exercise: sleep, hydration and

feeding/food substitutes, immersion in water, stretching, walking, jogging, swimming, massage (Halson, 2013), but also physical therapy, active rest at subalpine altitudes, walking through parks and forests, air therapy. Although hydration, nutrition and sleep have been reported by athletes as important components of the recovery process, they are considered by some experts as a lifestyle rather than a deliberately chosen strategy (Crowther et al., 2017), as we did too.

Based on the analysis of the state-of-the art empirical research on endurance running, we have built a general theoretical model of research from the doctoral thesis (Figure 1/10).

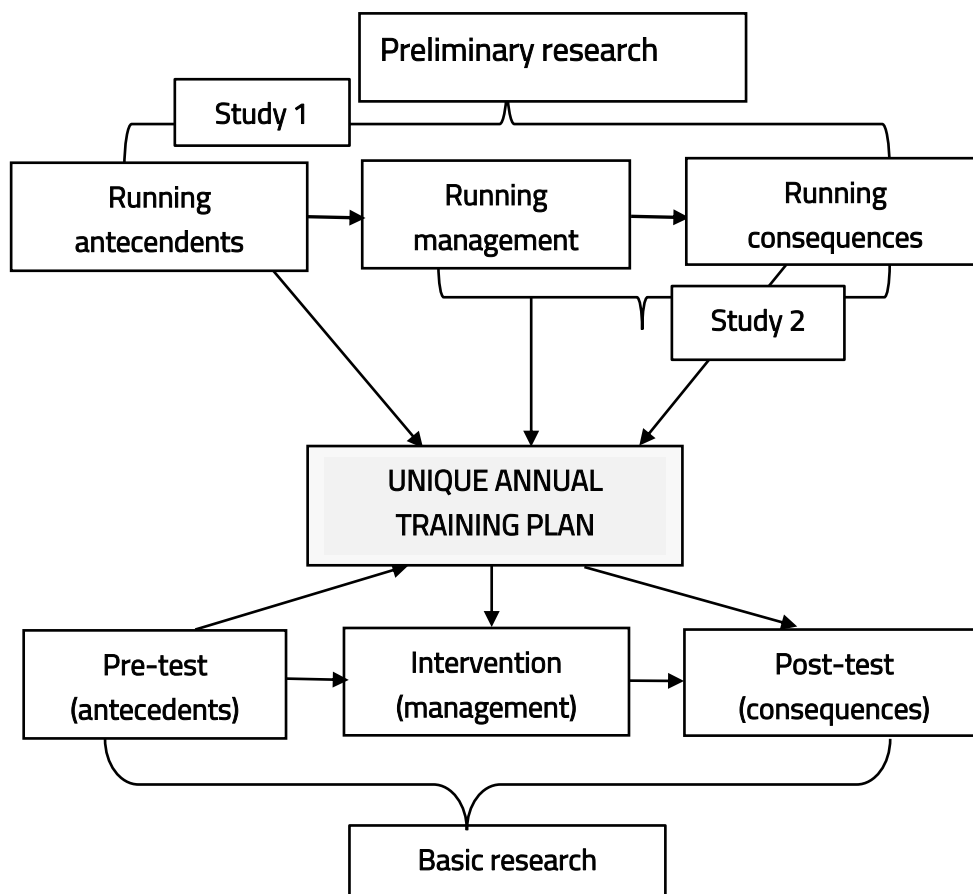


Figura1/10. Research General Model

Note: the first number (1) is the number of the figure (table) in the summary, the second (10) is the number of the figure (table) in the thesis.

The model suggested proposes running as a behaviour with multiple antecedents, which are not always causes, it must be monitored, managed and has numerous consequences on the athlete, on his performance or the environment. This model is used to better understand the factors that influence behaviour and to develop effective interventions for behaviour change.

The entire research was carried out in accordance with the Declaration of Helsinki (2013) and with the General Data Protection Regulation - GDPR (2016): the questionnaire was anonymous, the questions did not concern sensitive data, the data processing was done for scientific purposes. The athletes' consent was requested verbally, the questionnaires being applied on paper. Potential participants, capable of making independent decisions, were informed that there were no risks involved in participating in the research.

PART 2. PRELIMINARY RESEARCH

CHAPTER 5. PRELIMINARY RESEARCH BACKGROUND AND DESIGN

Preliminary Research Methodology

The extent of half-marathon events in recent decades is mainly due to amateur participants, who have achieved unexpected performances in many competitions, even if they started long-distance running as a recreational activity. Among them there are both young and old people, with various occupations. If initially more men participated in this type of running, in recent decades the number of women has increased at a faster rate than that of men (Bonet et al., 2022).

The scientific interest in studying the training processes and behaviour of athletes participating in the half-marathon is still limited, and studies using groups from Romania are even fewer, to our knowledge. In recent decades, the amount of research devoted to this sport has increased, but the information and results are often inconsistent. The variation of the results is dependent on the populations on which the studies are carried out, on the individual, biological and psychological differences, or on the social or geographical context in which the training and sports events take place, on the instruments used or on the theoretical substantiation of the research.

Under these conditions, our work aims to contribute to the optimization of the half-marathon training, using the results of previous studies and my own experience as a person practising this sport. In order to base our approach on scientific arguments, we designed, organized and carried out preliminary research, including two studies to contribute to a better understanding of the ways in which half-marathoners train, as well as their behaviour.

The general objective of the preliminary research is to describe and explain the relationships between sequence-specific variables of the antecedents of the half-marathon practice, training management and consequences of running and the relationships within each sequence, in the perception of half-marathoners in Romania (figure 2/11). The prediction of competition results is another main objective, which can contribute to the substantiation of the basic research.

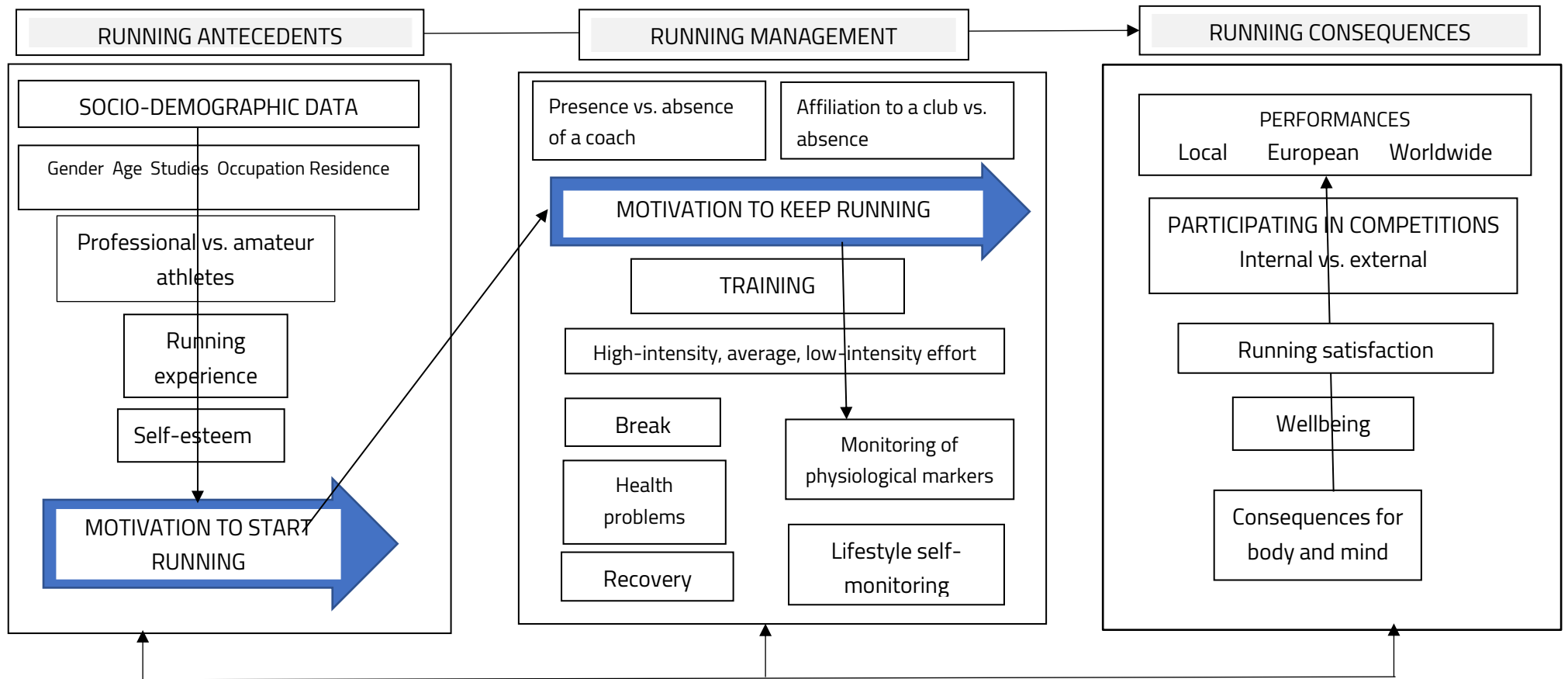


Figure 2/ 11

Research model for studies 1 and 2: relationships among running antecedents, management and consequences within sequences

The preliminary studies were carried out in parallel, involving, in accordance with the rigors of the method, the same stages, arranged in other time intervals, starting from the fall of 2019. Successively, they are: documentation, the development of tools or choosing them from among the existing ones, group selection, application of tools, statistical processing and data interpretation, and writing the research report (Singly, 1998).

The research methods used for carrying out the preliminary research are imposed by the objectives of the studies, by the specific content of the topic addressed, but also by the desire to obtain a research of good scientific quality that provides truthful results to substantiate the training schedule for the half-marathon trial. For the open-ended questions in the questionnaire, we used qualitative analysis. The open-ended responses were processed using content analysis, where data are organized along the way after they have been obtained. The two types of data processing make our research a mixed research, chosen for the richness of the data provided (Clinciu, 2007; Cocoradă et al., 2014).

Data interpretation was based on statistical results, such as significance thresholds (p) for t-tests, chi-square or correlations. If significance thresholds or correlation coefficients reached 5% at the most, the null hypothesis was rejected and the alternative hypothesis was accepted.

Based on the interpretation of the results related to each hypothesis and to the specialized literature, the discussions were built, which involved the development of explanatory arguments for the results obtained by us, by referring to the literature in the field. The main results with their strengths and weaknesses were analyzed, but divergent results compared to previous studies were also mentioned, for which we tried to build explanatory arguments.

In order to evaluate the quality of the research, we analyzed several criteria, among which we mention the adjustment of the research method to the formulated hypotheses/questions, the quality of the tools used (validity, internal consistency), the selection of participants and the group volume, adequate statistical analysis of the data.

CHAPTER 6. 1st STUDY – ANTECEDENTS, MANAGEMENT AND CONSEQUENCES OF RUNNING THE HALF-MARATHON

There are several studies that have reported results on the antecedents of running behaviour, followed closely by studies that have reported results on the psychological effects/consequences or outcomes, but few studies have simultaneously examined the antecedents and consequences of running (Pereira et al., 2021). Wanting to fill this gap in the empirical research, we focused in our paper on both the antecedents and consequences of endurance running, to which we added a training management component.

Participants and tools

In the first study 109 self-selected half-marathoners participated, men (62.4%) and women, aged over 35, of higher (85.3%) and secondary education, of which 87.9% are residents of urban areas, the majority being married (64.1%). Practicing the half-marathon is distinguished, in the group investigated by us, by the following characteristics: 28.4% of the participants were professional

athletes, but most are amateur athletes who run the half-marathon as a recreational activity. Less than half (41.3%) are registered with a club and the vast majority (87.2%) do not have a personal trainer. The composition of the group reflects the situation in Romania: the proportion of women in the group of the 1st preliminary study is 37.6% and in what concerns the athlete status, 78% of the study participants are amateur athletes.

The factor analysis of the items in the Scale on the consequences of running the half-marathon over the body and mind distinguishes two factors, slightly correlated, with acceptable internal consistency for the subscales and good for the scale as a whole (0.72). The predictive validity, verified for athletes' performances at various levels (world, European, local), relevant in the field, is confirmed: $r=0.21$, $p=0.001$ for the integral scale and $r=-0.18$, $p=0.03$ for days off. The evidence presented shows that the tool is reliable and can be used in research. However, these qualities do not exclude the possibility for its improvement.

Content analysis, a qualitative method, allowed us to summarize the participants' free answers, generating categories of motivations, proposing definitions and labels, partly new, partly taken from the specialized literature to favour comparisons with other studies. Using the mentioned themes/categories, we categorized the participants' responses, establishing frequencies for classes and subclasses. We identified five categories: 1. orientation towards physical health; 2. orientation towards the subjective state of wellbeing; 3. affiliation and membership; 4. social recognition; and 5. orientation towards self-improvement. The qualitative approach was used, in the same way, to reduce the answers regarding health problems and recovery techniques reported by Romanian athletes.

Testing hypotheses

We categorized the research hypotheses according to the sequence in which they can be placed: running antecedents (1), behaviour management (2), and running consequences (3). Because the number of variables is greater, we formulated complex hypotheses with several parts (a, b, c) that were tested in turn. When only one of the components (a, b or c) was confirmed, we stated that the tested hypothesis was partially confirmed.

Testing the hypotheses from the 1st preliminary study shows that the most significant differences among participants subgroups, created according to various criteria (gender, athlete status), concern amateur athletes and professional athletes, followed by gender-dependent differences. Motivations that concern the wellbeing are at the top, followed, in order, by motivations that concern physical health, affiliation and self-improvement, the less important being social recognition. Similarly, self-improvement and social recognition motivations tend to be more common in professional half-marathoners as opposed to amateur athletes, in line with other studies. We mention, from another perspective, that 72.5% of the athletes surveyed reported intrinsic motivations for endurance running, as we showed in a study, we previously published (Baba & Balint, 2021a).

Unlike some studies conducted in other countries, in our group there are no differences between women and men regarding social recognition, an absence that can be explained by the trend already noted, regarding the increase of motivation for social recognition in women (Frick, 2011) or by the very good results obtained in some competitions by sportswomen (Knechtle & Nikolaidis, 2018).

These results may be caused by physiological advantages that women have in long-distance races (McClelland & Weyand, 2022), but also by changes in gender equality within the general social context.

We wish to emphasize that our study distinguished the motivation to start running from the motivation to keep running, which led to interesting, new results not seen in other studies. Thus, the motivation for *physical health* is more frequent when starting running, and the motivation for *subjective wellbeing* is more frequent when maintaining the participation in the half-marathon. Positive self-esteem is higher in the women than in the men in our group, as opposed to other studies. The differences may be caused by the small volume of the Romanian group, but we could also invoke the explanations from the previously cited study (Frick, 2011), regarding changing trends in women's motivation for practicing sports and, probably, attitudes towards themselves.

Compared to women, men report a significantly higher number of high-effort training days and women a higher number of rest days. High-intensity and average-intensity efforts are more common in professional athletes, and low-intensity efforts and resting time are more common in amateur runners, but the differences do not reach the threshold of statistical significance. Athletes who have a coach tend to have fewer low-effort days per week compared to athletes who do not have a coach.

The athletes we surveyed mostly report no injuries, training-related or competition-related injuries (Baba & Balint, 2021b). They use as recovery methods: lifestyle, no special interventions consisting of hydration, nutrition, sleep, followed by combinations of several recovery methods and light exercise/active rest. Massages, physical therapy, physiotherapy, sports medicine, immersion in water, although present, are used in small proportion, the majority of participants being amateur athletes (more than 70% of the total group).

Athletes who report more rest days experience poorer effects of running on the body and mind and participate less in world competitions. The number of days without running (breaks) is found to be negatively associated with both favourable consequences on the body and mind and with performance. We can say that engaging in high effort during training influences performance at all levels, but being a professional athlete directly influences world and European performance, while national/local performance is significantly influenced by running experience. Our results support previous research on the performance of endurance runners, where greater effort in weekly training holds as a significant explanatory factor, along with the running experience.

In all regressions calculated in this chapter, the coefficients of determination (R^2) are not large, but they are admitted in the behavioural sciences, where a variable is multiple determined (Sava, 2004). In other words, sports performances are also explained by other factors, not studied by us.

The main limitation of the 1st study results from the small number of participants, which can be explained by conducting the research during a period of social isolation. This fact leads to the presence of a small number of cases in the subgroups created according to the chosen criteria, making comparisons difficult. Dichotomizing continuous variables (Yes=1, No=0), so without using a median split, may lead to loss of information regarding individual differences. The presence of dichotomous variables reduces the correlation coefficients and sometimes leads to the conclusion of the absence of associations, which might not hold under other conditions. Thus, the analyses performed should

be interpreted with caution (MacCallum et al., 2002). The reformulation of the items and attaching scales with several steps would shed some light on the analyzed variables/behaviours. Also, using scales known in literature to measure motivation would have allowed an easier comparison with previous studies. Through qualitative analysis, using already existing categories, we tried to reduce this disadvantage as well.

CHAPTER 7. 2nd STUDY – MANAGEMENT AND CONSEQUENCES OF RUNNING THE HALF MARATHON IN MASTER ATHLETES

The seventh chapter describes and explains the relationship between the consequences and management of endurance running in a group of master athletes, according to gender, running experience, mental preparation before the sporting event, effort in terms of kilometres made per week, the presence of pain and injuries during training, complying with the rehabilitation time indicated by the running clock. Other variables are also included, such as: performance level (local, European, world), running satisfaction, wellbeing, self-monitoring of physiological indicators and lifestyle self-monitoring. Based on the specialized literature and on personal observations, we formulated several hypotheses, grouped, as in the 1st preliminary study, according to their placement in the management sequences or in the consequences of endurance running or at their crossroads.

Participants and tools

The total number of participants in the 2nd study is 81 master athletes, of which 52% are men, 84% have higher education studies, 83.7% are occupationally active and live in urban areas (95%), most of them being married (75,3%). From this group of 81 participants, a subgroup of 13 women athletes was selected who were asked to state the competitions they participated in, the places they were ranked in, and describe a training microcycle from the pre-competition period: *Describe the volume and intensity of a week, as training sample at the highest level of training.* For the running monitoring dimension, extracted from the *Postgoal Analysis* questionnaire, which also includes the item mentioned for the 13 female athletes, we requested and obtained the written consent of the author (Utzschneider, 2014).

In the 2nd study, we used a mixed questionnaire, developed by us for research needs and we added a scale on the wellbeing adapted from Ryff and Keyes (1995) and our own Running Satisfaction (SSA-Sm) Scale. Regarding the monitoring of sports activity indicators and physiological indicators, we asked for answers regarding time, distance and speed monitoring, respectively VO_2 max, heart rate and calories burned.

Before testing the hypotheses specific to this study, we validated the newly developed or adapted scales. By analogy with life satisfaction (Funk et al., 2011), we defined running satisfaction as a global cognitive evaluation of endurance running, resulting from the summing of positive personal experiences related to this activity: dynamism, vitality growth, improving body image, self-confidence improvement, self-control improvement, increasing wellbeing, happiness and improving the quality of life.

Cronbach's Alpha for the whole Running Satisfaction Scale (SSA-Sm), is 0.92, and the Pearson correlation between running satisfaction and runners' wellbeing is positive, moderate in intensity and strongly significant ($r=0.42$, $p=0.001$). We can conclude that the scale developed for the second

preliminary study has very good psychometric qualities. In the *Wellbeing Scale*, adapted from Ryff et al. (1995), we replaced the items with the six dimensions of the scale, identified by the authors and briefly defined. Due to this personal approach, we proceeded to validate the scale on the studied group. We used factor analysis, extracting a single factor, for which Cronbach's Alpha is excellent (0.94).

Testing hypotheses

The participants in the 2nd preliminary study report that they train 5.4 weeks before participating in a competition, they run an average of 52.8 km per week, with large individual variations: some do not train at all, others run 95 km. Only 44.4% comply with the recovery time indicated by the smart watch and very many (81.5%) have a rest day. Running satisfaction and wellbeing are negatively associated with the running experience, but positively associated with lifestyle self-monitoring and mental preparation before the sporting event. Our results do not support the idea that wellbeing and running effort are associated (Nezlek et al., 2017), but the cited authors found that this relationship is mediated by progress satisfaction, a variable we did not explore.

Self-monitoring of physiological indicators is more pronounced in older athletes, compared to younger ones. As running experience increases, monitoring of physiological indicators, running indicators and lifestyle decreases. Also, the decrease in wellbeing scores in the age segment of participants over 59 years is confirmed (Springer et al., 2011). The inverse relationship between wellbeing and age is also found in the general population (Everard et al, 2000), but our study replicates it in endurance athletes and extends it to running satisfaction.

Therefore, at older ages it becomes necessary to increase or maintain running satisfaction and wellbeing in athletes. In relation to gender, we did not identify statistically significant differences, as found in other research.

Calculated hierarchical regression equations show that running satisfaction is more strongly influenced by wellbeing, but monitoring some characteristics of running, such as time, diminishes satisfaction. Time being the official measure of half-marathon performance, measuring it probably creates stress and decreases satisfaction. The positive influence of pain, accidents during trainings/competitions (increases running satisfaction), is unexpected. A possible explanation can be a higher pain tolerance found in endurance athletes (Roeh et al. 2020). We assume that overcoming pain through self-control and continuing the race could be felt by some athletes as proof of resilience, although delaying the decision to withdraw from the race in case of injury can be dangerous. The study of these relationships deserves to be resumed in future research, as their practical implications are great.

The attempt to find a training pattern associated with competition performance did not provide conclusive results: certain effort volumes, weight of long running, effort intensity, are not associated with the same level of performance. We tested this hypothesis on the subgroup made of 13 female amateur athletes. The results show that some female athletes (5) use only one type of microcycle training (long-term running) for distances between 7 and 15 km daily, with one or two days of rest. Other combinations include, in various proportions, Fartlek running, interval running, easy running, launch runs, and less commonly elevation gain (one mention). We expressed performance by the best

finish time achieved by the female athletes in competitions over the past three years (2019-2022), the average best finish time in half-marathon competitions being 1:33:51. The competitions in which said times were obtained are EMAC Venice Italy (5 athletes), Wizz Air Cluj - Napoca (3 athletes), EMACNS Alicante Spain (2 athletes), Wolkswagen Bucharest Half Marathon and one athlete each at the Raiffeisen Bank Bucharest Marathon and Băneasa Race Winter, the last three sporting events being held in Romania. The hypothesis is not confirmed, as more studies are needed.

The results of the 2nd preliminary study cannot be generalized due to the small number of participants. Also, using the wellbeing scale in a shortened form, although having acceptable psychometric qualities, does not guarantee the correctness of comparisons with other research. We believe that the study is useful, deepening the understanding of the athletic, demographic and psychological factors involved in the practice of endurance running and achieving performance. The results suggest recommendations for runners and coaches regarding factors related to maintaining effort during exercise and generating running satisfaction and wellbeing (Baker & Horton, 2004).

Running satisfaction is particularly important in half-marathon practice, as it supports motivation during training and competition, a role also emphasized in other studies (Kędra & Laguna, 2022). From the perspective of the popularity of the half-marathon and the beneficial effects on health, the satisfaction generated by running is more important than the prizes, which are the prerogative of a small number of athletes. The great majority of half-marathoners run for maintaining their health or for the subjective wellbeing, goals of many individuals and of society as a whole. In reaching them, sport competes with medicine, as it is more accessible, preventive and associated with positive emotional states (Crawford, 2006). Therefore, it is worth creating, preserving and developing it, with positive experiences increasing the attraction to actually participate in sports events, even if other personal goals are not fully met.

PART 3. BASIC RESEARCH

CHAPTER 8. BASIC RESEARCH DESIGN

Along with the changes favoured by the social context, the rapid increase in women's participation in endurance running was also the result of the use of appropriate training programmes. Physiological gender and age differences, as well as individual characteristics, have raised the question of training adjustment (Bonet et al., 2022), but the answers are not clear and univocal.

As it results from our preliminary research, many Romanian athletes are interested in obtaining the shortest possible times for covering distances, in the social recognition of their efforts, being concerned with the efficiency of training. The same preliminary study showed that 55.9% of athletes get injured during training or competitions, some performing demanding activity, sometimes exceeding 100 km per week, often followed by excessive fatigue, which can make it difficult to maintain their motivation and can decrease running satisfaction. The training of amateur sportswomen is carried out under the conditions of maintaining professional and family responsibilities or with the specific needs of various age categories.

These situations lead to the search for economical training strategies, in order to maintain the productivity within optimal limits, as well as the positive effects on physical and mental health. The

time intervals for which these training plans are developed are multiple: 12 weeks (Bonet et al., 2020), 20 weeks (Boullosa et al., 2021) or 12/15/32 weeks (Galloway, 2016). There is also the opinion that establishing a training plan for a year would be of great importance (Bompa & Haff, 2009). Experimental or quasi-experimental verification of the effectiveness of these training plans is rare or limited to elite athletes (Stöggl & Sperlich, 2015).

The aim of the basic research consists in the development and application of a physical training programme, staggered for the duration of a competition year. The basic research model (Figure 3/31) is subordinated to the general model of the approach in this study, which uses the sequence order: antecedents, running management and running consequences.

Research Methodology

To achieve these objectives, we used the experimental design with a single group, using pre-test and post-test. The specific relationships of the basic research are represented in Figure 3/31, which also highlights the methodological unity of the thesis.

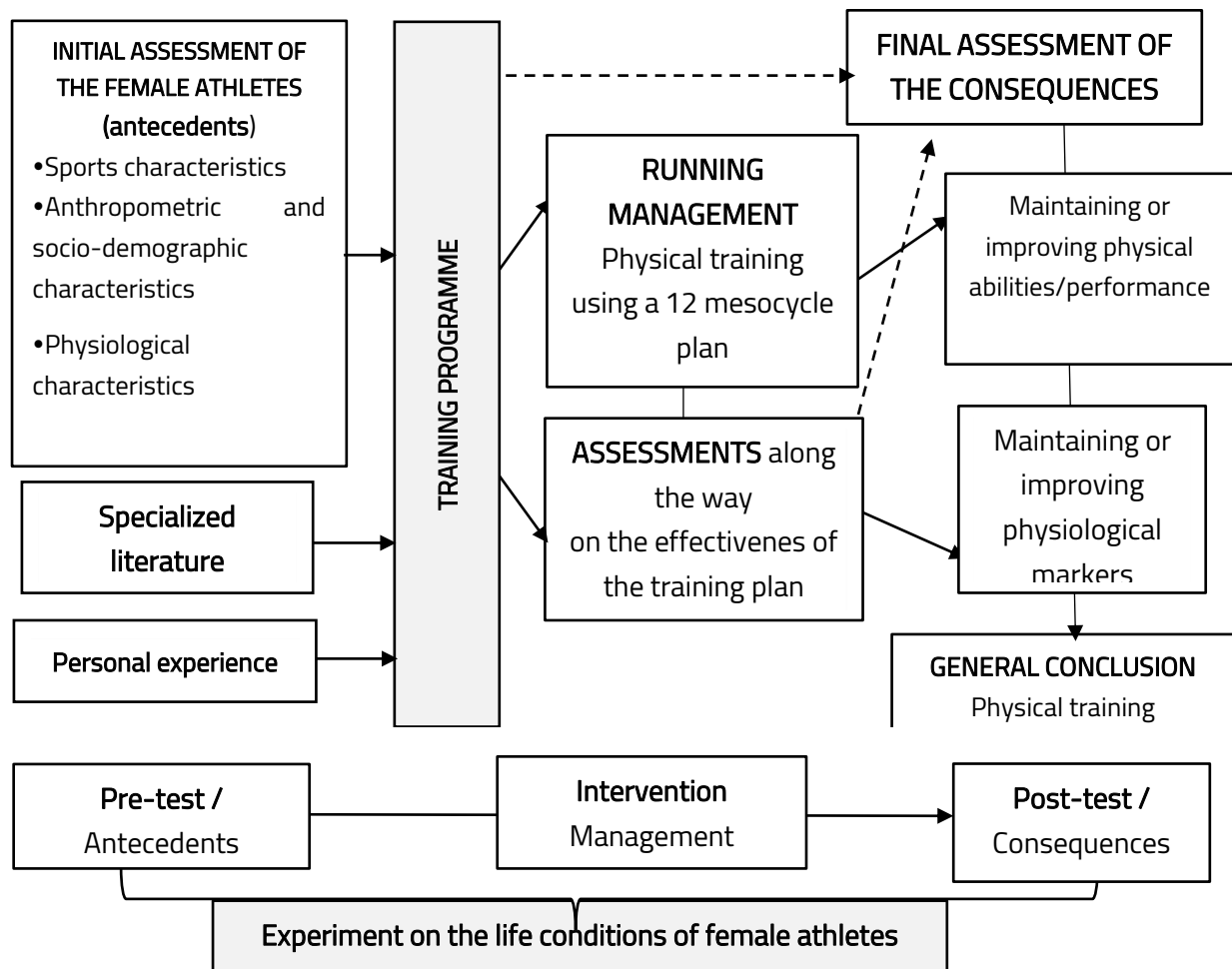


Figure 3/ 21. Conceptual model of basic research

The experiment we propose is an improving/formative/pedagogical experiment, as it aims to shape behaviour, improve or at least maintain sports performance. Only one group participated in the experiment, which benefited from initial and final measurements, for a more rigorous control, as recommended in the research methodology (Cazan, 2015), but additionally intermediate

measurements were engaged. The independent variable is represented by the annual physical training plan for the half-marathon (PASm-12), applied by each participant in their personal training, during 12 mesocycles, and by the anthropometric, socio-demographic and physiological data of the athletes. The dependent variables are: the time per km or race obtained in sports competitions in which the sportswomen involved in the experiment participated in and the physiological markers identified in the final laboratory testing.

We believe that the validation of the unique training plan can be assessed by: 1) obtaining in the scheduled tests times similar to those of the international half-marathon competitions, that is under two hours per race or obtaining times close to the best finishing times of the participating sportswomen; 2) obtaining in the field tests identical or close times to those proposed in the training plan for the integrative microcycle of the intermediate assessment test; 3) obtaining times on the field that are close to the times estimated in the laboratory; 4) improving or maintaining the performance-enhancing physiological characteristics of sportswomen. In accordance with these considerations, we formulated and tested the seven basic research hypotheses.

The following methods were used in the basic research: the method of studying the specialized literature, the experiment method (the main method), the survey method based on a questionnaire, the method of document study, statistical methods. These methods were briefly described in the thesis. The experimental group includes six sportswomen who practice long-distance running, both indoor and outdoor, road and mountain running and who fall into the age categories 45-49 and 50+, are registered with sports clubs in Romania affiliated to FRA and have over 10 years of experience in endurance running but do not have personal trainers. The participants all live in urban areas and have various professions. For a deeper understanding of the effects of the training plan, I presented the personal and sports profiles of the participants in the improving experiment and graphically represented the competitions they participated in before entering the experiment (Figure 4/36). Symmetrically, at the end of the experiment, we made the final profiles of the participants (initial boxes 8.1-8.6, respectively the final ones, 10.1-10.6).

Box 8.3

Female athlete S3**DOB:** 28.07.1974:**Profession:** Physical Education teacher, Mediaș;**Studies:**

- **Master Studies:** Lucian Blaga University of Sibiu, Master Degree in School Physical Education, class of 2010;
- **Bachelor Studies:** Vasile Goldiș West University of Arad, Faculty of Physical Education and Sports, class of 2008;

Running debut: 1990**Affiliation:** Athletic Star Club of Mediaș.**Prior record (selective) (Figure 4/ 36):**

30 competitions in the last 7 years

- 1st place – Masters Indoor National Championship, tartan, 1500 and 3000 m. Bucharest, 2021;
- 2nd place, general – International Marathon, Sibiu, 2021 (45+);

- 1st place – Masters Running National Championship, Beiuș, 2021 (45+);
- 2021 – 15 competitions, inside the country and abroad, mountain and road running.

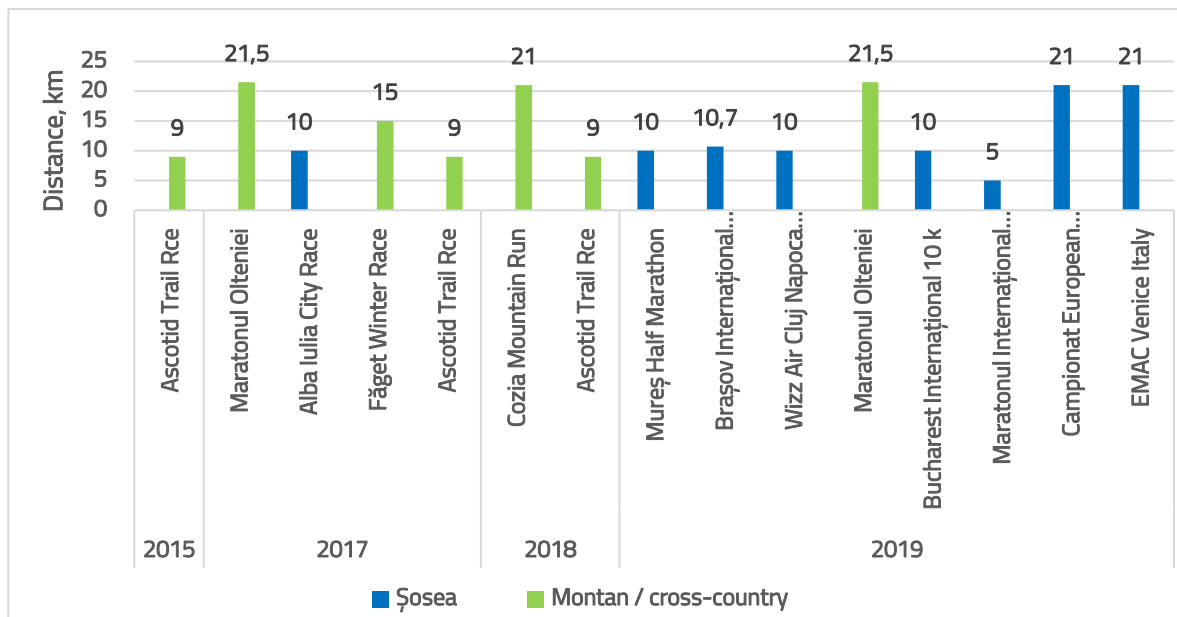


Figure 4/ 36. S3 – Participation in competitions from 2015 until 2019

The initial diagnostic tests (part of the pre-test) were performed at the Mens Sana Centre in Cârța, Harghita county, as well as the final ones (part of the post-test). The anamnesis showed that the athletes in the experimental group had no cardio-respiratory pathologies and no history of injury in the last six months.

After the initial medical examination, there were five field checks, a non-specific test, involving a 10 km road run (Zărnești), three tests specific to the half-marathon test in Cluj-Napoca, Oradea, Brașov and an official test, carried out in Grosseto, Italy, at the European Masters Championship (European Masters Athletics Championships Non-Stadia - EMACNS) (May 15, 2022). After the testing in Grosseto, other field tests followed, at the choice of each athlete, carried out by participating in various competitions, depending on family, professional and financial constraints. A necessary step in conducting the experiment was the purchase of four Garmin Fenix 6S PRO watches with GPS technology for training monitoring.

The assessment of the technical qualities of the plan (effort volume per macrocycle, volume and intensity per mesocycle, presence/absence of alternative means of training) was carried out based on a self-administered questionnaire, developed by us, *Half-marathon training plan satisfaction* (SPA-Sm). Other data are results from field measurements, performed with the smart watch, from laboratory measurements or they are data extracted from public competition results.

CHAPTER 9. DEVELOPMENT AND IMPLEMENTATION OF THE ANNUAL TRAINING PLAN

Development of the unique annual physical training plan

The unique annual half-marathon physical training plan (PAsm-12) is the independent variable in the basic research. After development, the work plan was analyzed together with the participating sportswomen to amplify the commitment and increase the motivation to implement it. PAsm-12 runs consistently over 12 mesocycles and 52 microcycles, each microcycle consisting of 4 or 5 training sessions. Since training does not take place every day of the week, there are 235 training days. Some microcycles are identical and others vary, depending on mesocycle and stage goals.

The training plan proposes a training of moderate intensity at the beginning (70% of the heart rate) and a small effort volume (40 km), indicators that increase gradually. Our option is linear, traditional periodization, preferred because the selected athletes have already various motor skills and training routines, the latter of which may constitute impediments to applying the annual experimental programme. The training sessions were programmed in such a way as to allow the physiological recovery of the participants and favour, at the same time, physiological adaptation.

The structure of the plan includes: the training period (general and specific), the pre-competition and competition period and the transition period. For each training period in PAsm-12, we have established the time interval, described the type of training, the objectives, the specific content, and provided brief suggestions to the female athletes. The microcycles show the means of training, the effort volume (km) and the recommended percentage of heart rate (intensity). We paid special attention to microcycles, in agreement with experts who say that this is the most important part of the training plan (Bompa & Huff, 2009). For a better understanding, we integrated the plan development phase with the implementation phase, so that we presented the proposed microcycles, but also the extent to which they were applied by the participants.

For illustration, we will extract sequences from the training plan, from various training periods. Table 1/73 and Figure 5/53 are a pair, showing the effort volume and intensity in the 4th mesocycle, broken down into training sessions, with the maximum heart rate specified as an indicator for the effort intensity. In the chart, the vertical bars represent the effort volume achieved by each athlete in the 4th mesocycle, and the zigzag line represents the achieved heart rate, which is also dependent on each athlete's maximum possible heart rate. Although they were consistent in applying the unique physical training plan, the six sportswomen fulfilled it in various proportions.

Table 1/73. Training means used in the 4th mesocycle – 03.01.2022-30.01.2022, PFS-weeks 14-17

Microcycles 14-17	Day	Training means	Dosage	
			Volume (km)	Intensity (% Fc max)
Training 1	Tuesday	Long-term running with pre-set tempo (5'40"- 5'30"/km)	10	80%
Training 2	Thursday	Interval running (3x2000m), break 2' (walking)	6	90%
		Moderate tempo long-term running	6	60%
Training 3	Saturday	Elevation gain (80-100m)	14	65%

Training 4	Sunday	Long-term running with pre-set tempo (5'10"-4'50"/km) Zărnești - test 1-	10	85,00%
Total V/I	4 days		46	76,25%

Note: the first number (1) indicates the table number in the summary, the second (73) is the table number in the sentence.

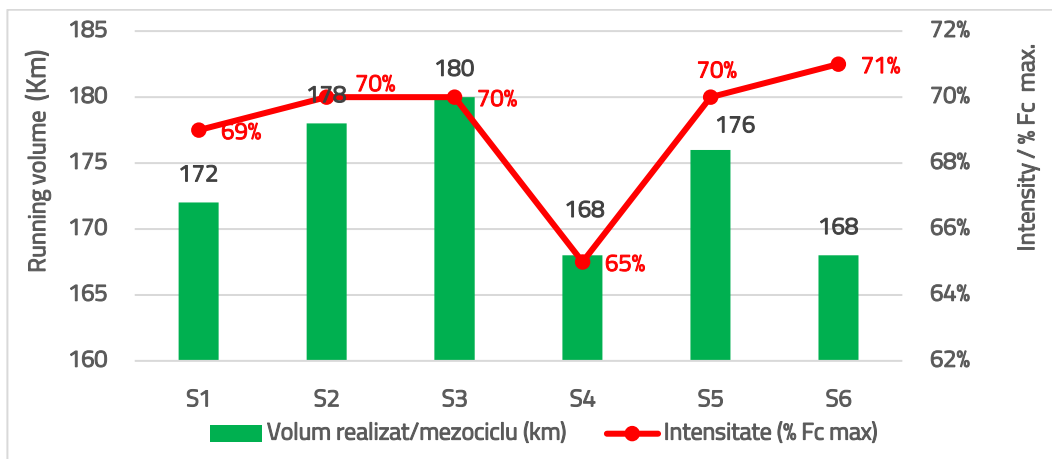


Figure 5/53. Graphical representation of effort volume and intensity achieved by the female athletes in the 1st mesocycle IV- 03.01.2022-30.01.2022 (PFS-weeks 14-17)

From the competition period, I selected microcycle 28. The training means, the dosage of the effort are presented in the table and their application appears in the graphical representation (Figure 6/65) that follows.

Table 2/ 90. Training means used in microcycle 28 (11.04.2022-17.04.2022, PC-week - 28)

Microcycle 28	Day	Training means	Dosage	
			Volume (km)	Intensity (% Fc max)
Training 1	Monday	Long-term running with pre-set tempo (5'40"-5'30"/km) 12 km	12	80,00%
Training 2	Tuesday	Interval running 2x800m, break 3'(walking)	1,6	95%
		2x1600m, break 5'(walking)	3,2	90%
		2x2000m, break 6'(walking)	4	90%
Training 3	Wednesday	Elevation gain long-term running (80-100m) 10 km	10	60%
		Interval running 5x200 m, break 2'(walking)	1	95%
Training 4	Friday	Fartlek running 10 km	10	70,00%
Training 5	Saturday	Long-term running with pre-set tempo (5'40"-5'30"/km) 21 km Brașov-test 4	21	85,00%
Total	5 days		62,8	80,83%

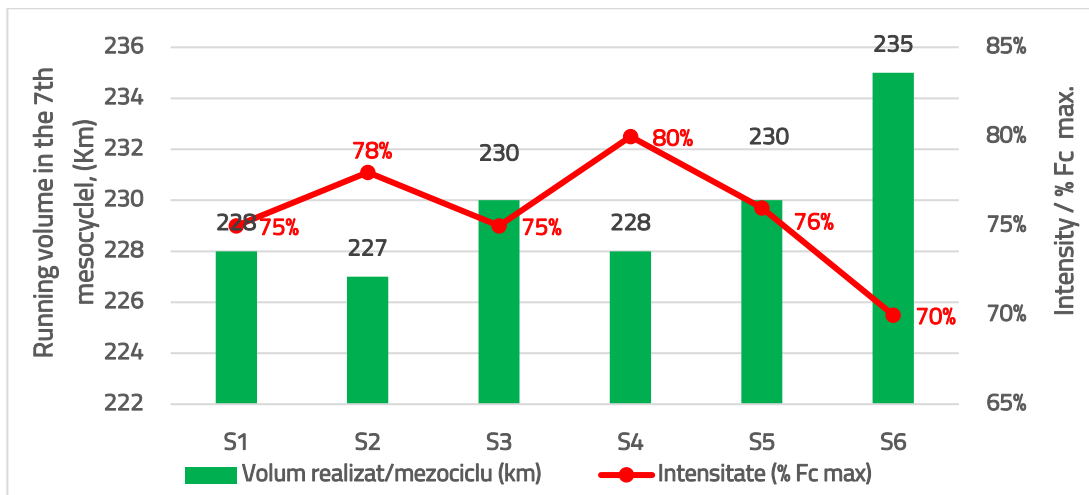


Figure 6/ 65. Graphical representation of effort volume and intensity achieved by the female athletes in the 7th mesocycle – 04.04.2022-01.05.2022 (PC-weeks 27-30)

On the whole of the experiment, the percentage value of the specific means used in the proposed annual training plan is as follows: long running with pre-set tempo (5'40"-5'30"/km) is the most used specific means, and with this speed we propose covering 883 km, 34% of the total, while elevation gain and long running with pre-set tempo (5'40"-5'10" / km) are the least used means (94 km and 120 respectively km), representing 5% of the total. A summary image, throughout the macrocycle, of the effort volume proposed and its intensity can be found below (Figure 7/82).

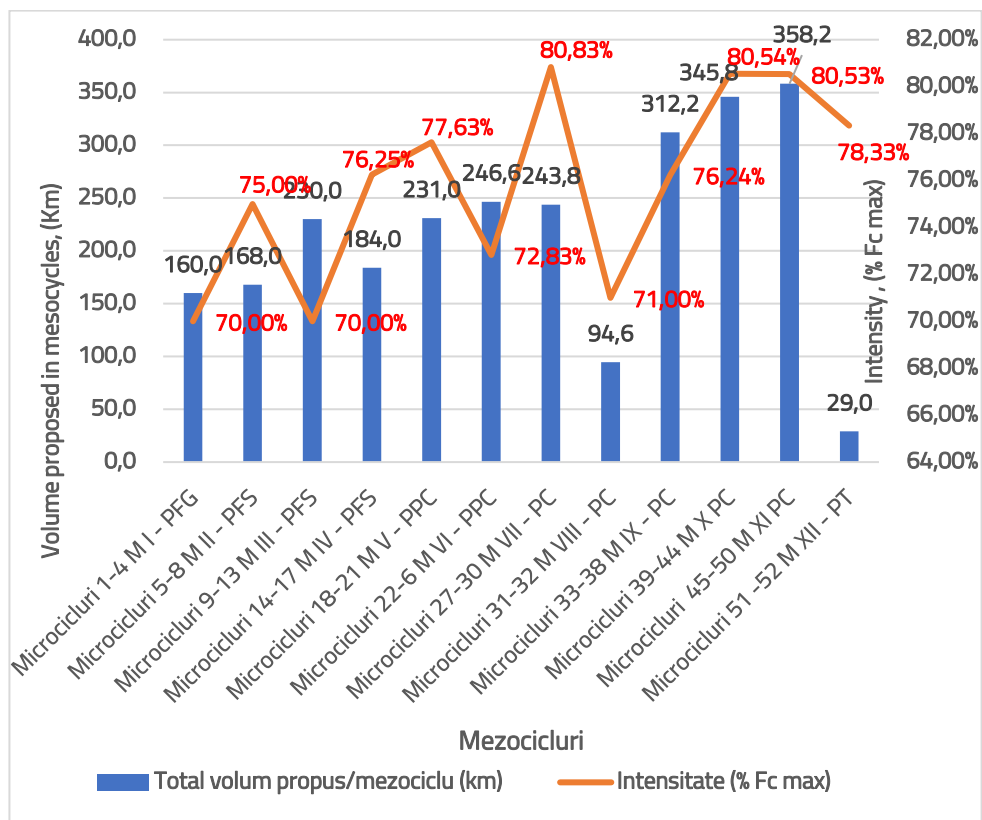


Figure 7/82. Dynamics of effort volume proposed and of intensity, on mesocycles

CHAPTER 10. ASSESSMENT OF THE ANNUAL TRAINING PLAN

After the description of the proposed training plan, by parts and in synthesizing the most important characteristics, as well as the way in which it was applied by the participants in the experiment (the actual effort volume and its intensity), we checked the hypotheses to decide on the extent to which the plan was applied, its adequacy and effectiveness. We added to these checks a final "cold" assessment made by the participating sportswomen after the completion of the basic research.

Testing hypotheses

Since the experiment is carried out in the natural environment of the participants, a major challenge is the very application of the proposed unique annual training plan, which is also the necessary premise for confirming the main hypotheses. Across the entire group and the entire training cycle, there is a difference of almost 256.2 km between the total volume proposed and the volume actually achieved, which corresponds to an average implementation percentage of 90.2%. So, the plan was not fully applied, which is expected for an intervention carried out in natural conditions and for a very long time.

In the experimental strategy, the initial testing / pre-test constitutes a reference point for the results obtained at the end (post-test) or along the way. After determining the main physiological indicators relevant to endurance running, the finishing times for the distances of 1000, 5000, 10,000 half-marathon and marathon were estimated for all female athletes.

Wanting to check how effective this plan is, under the given conditions, we compared the times obtained in the field checks with (i) the times proposed in the plan, (ii) the times estimated in the laboratory and (iii) the best finishing times in the last three years. The results are satisfactory, showing that all field times are under the two-hour benchmark for the half-marathon, lower than the maximum values we proposed in the plan for the mesocycle in which the field check is carried out. These times are, most of the time, lower than the proposed average values. Also, the times estimated in the laboratory and the times obtained in the field are statistically equivalent, the female athletes being able to use their advantageous physiological characteristics and motivation for running in conditions of real, international competition. These results give us reasons to state that the unique physical training plan proposed by us is effective. The hypothesis regarding the maintenance of the sportswomen's performance (EMAC Grosseto, 2022) at the level of the best finishing times of the last three years is not confirmed, the difference being statistically significant against recent performances. We note that the participating athletes do not run mainly to achieve notable performances, but for the benefits of running on health and wellbeing. These conditions are typical of most amateur runners, as shown by our preliminary research. We assume that the proposed plan would be effective for many of them with inherent customizations.

The values of the main physiological markers, measured in the laboratory, do not show significant improvements from the initial to the final testing, so it does not present a new physiological adaptation after training, as found in young athletes, who practice endurance sport, purely for competitions. We believe that, for the sportswomen involved, aged 45+, with long-term training, with families and jobs, maintaining their fitness is a success. The success is also confirmed by the places occupied by the sportswomen participating in the official testing of the European half-marathon,

Grosseto, Italy, 2022, which constituted the main verification of the effectiveness of the proposed plan.

For an athlete to maintain a consistent and good pace, they must run at a heart rate very close to the functional power threshold or anaerobic threshold, but not over it. Since the lactate threshold can only be measured in the laboratory, we tried to verify whether it can be predicted based on other, more accessible physiological markers. Thus, we checked whether pulse values recorded during training predict lactate threshold, using regression with a single predictor (Table 4/126).

Table 4/ 126. Regression equations estimating lactate emergence as dependent on pulse values

Regression type	Simple linear regression				Exponential regression			
Regression characteristics	$R^2=0,53$		$R^2\text{adjusted}=0,51$	$F=38,06, p<0,001$	$R^2=0,73$		$R^2\text{adjusted}=0,72$	$F=91,27 p<0,001$
Coefficients and meanings	B	Beta	t	p	B	Beta	t	p
Constant	-7,599	-	-3,949	0,001	0,063	-	2,441	0,02
Pulse	0,078	0,73	6,169	0,001	0,026	0,854	9,554	0,001

We tested both linear and exponential regression to find a valid model to better approximate the lactate variation dependent on the pulse, easily measured by smart watches. It is found that the exponential model has a higher coefficient of determination than the linear model, and the influence of pulse on lactate is direct and highly significant, higher than in the case of linear regression (Table 4/126). This model is aimed at female athletes with medium to high experience in the half-marathon event, being more accurate for pulse values up to 140-150 bpm and becoming less accurate for higher pulses, according to the Glejser equation, which we do not present in the summary.

Symmetrical to the initial boxes, we will present an example of a final box, which brings new information on the evolution of S3 female athlete, extracted from the 2nd preliminary study and the basic research. As mentioned, such boxes are developed for all six participants.

Box 10.3

S3

Until enrolling in this programme, the athlete ran, as a rule, 65 km/week, using exclusively long-term running, between 10 km (five days) and 15 km (one day), with a break on Sundays.

During the experiment, she achieved 95.2% of the training plan, the highest percentage in the group, the volume achieved in each mesocycle being represented in Figure 8/90. Consistent with the PAsm-12 objective, the times obtained in the field tests are located under the 2-hour limit for half-marathon events. In the intermediate field tests, she achieved the best times and in the official competition, Grosseto, she achieved a time of 01:39:41, being ranked 3rd place (W45).

Before engaging in the experiment, her overall running satisfaction was 25 points, higher than the group mean (27.16), and her wellbeing reaches 60 points out of a maximum of 60.

The athlete favourably appreciates the unique training plan implemented, obtaining a score of 96, the highest of the entire group. She does not report dissatisfaction above the group average, and the absence of alternative means of training is a favourable element for her. The greatest satisfactions are generated by the amount of effort proposed in training, improving and maintaining her fitness.

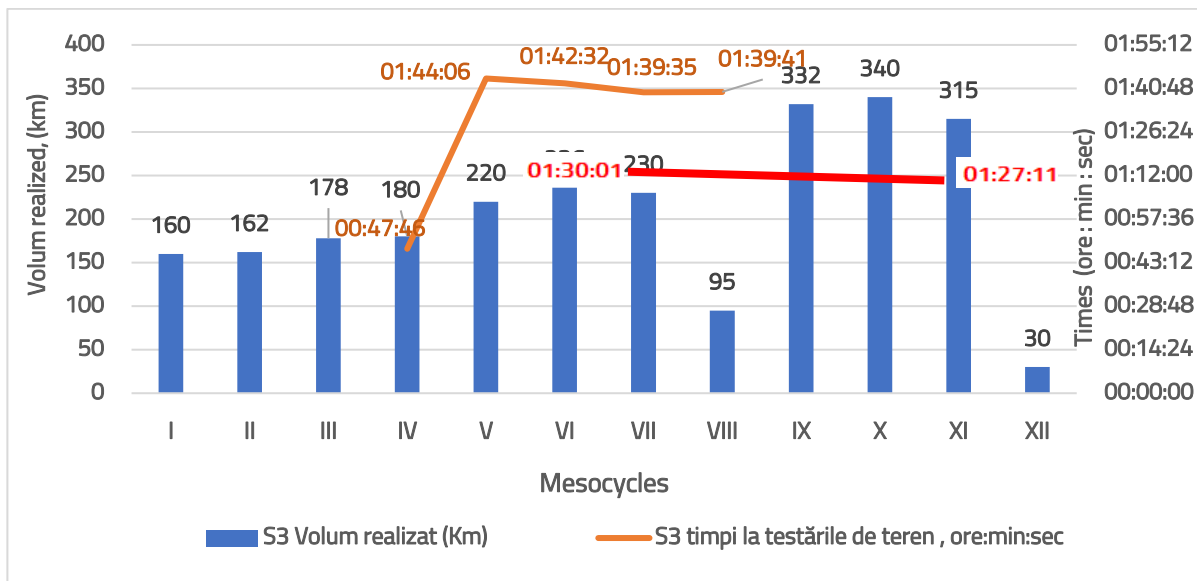


Figure 8/90. S3 female athlete’s evolution in the experiment: running volume achieved on mesocycles and the times obtained in field tests

She states in the open-ended questions that the proposed plan has helped her better pursue her personal goals and believes that more field checks are desirable. She participated in 10 competitions, in addition to those required by PASm-12. The athlete would recommend PASm-12 to her friends, without any doubts, at the highest level.

The participants' satisfaction with the unique training plan, measured after a reflection period, shows very good ratings in all aspects, technical, personal, affective and general aspects. Although only six, the female athletes participating in the experiment rated aspects of the plan in different ways, according to each one's preferences, problems and characteristics, and for this reason we assume that the ratings are honest.

The main limitation of the basic research is the small size of the group, caused by the difficulty of finding participants available to apply a single training programme of 12 mesocycles. The small group size may affect the generalization of the results to some extent. In the data processing, we tried to reduce this inconvenience by using the statistical procedure that generates samples similar to the original one (resampling/ bootstrapping) and we provided details about the sportswomen, as is done in case studies, in the hope that they can be sources of inspiration and comparison for other cases, situations similar to those described by us (Turcu, 2007).

The use of self-reported data by athletes can negatively influence their objectivity, and implicitly the research, but it was the only possible way of exploration.

The sportswomen participating in the PASm-12 validation are not only specialized in road running, they also practice mountain running, as shown by the competitions they participated in during the competition period, after the mandatory tests, but also before getting involved in the experiment (initial boxes). The tests performed were carried out only as road running and, for this reason, the developed plan should be seen as an indicative training strategy for the performance of half-marathon trials.

We also believe that not only the implementation of the unique training plan or the diversification of training methods, but also other factors that are difficult to control in a single-group experiment, contribute to explaining the endurance performance of the six female athletes in the experimental group. Among them we mention: a healthy lifestyle, embodied in suitable nutritional strategies, proper professional equipment, all of which are enhanced, frequently, by readings in the field or by the distances covered in hiking, as alternative training. These aspects interact effectively, being integrated into the daily routine and could be the subject of future studies.

The results are encouraging, both by confirming the effectiveness of the unique annual physical training plan and by the satisfaction reported by the athletes. This plan can provide amateur athletes with direction, reference points for comparison, being a plan that brings to fruition results from specialized literature and personal experience as an athlete. The arguments provided by the validation of the programme reinforce our belief that amateur athletes, sometimes at the crossroads of information with a questionable scientific foundation, which they cannot critically evaluate, can benefit from help in sports training.

GENERAL CONCLUSIONS

The thesis answers the initially established objective, that of testing an annual training plan to optimize training for the half-marathon test. The confirmation of most of the hypotheses allows us to state that the physical training programme is effective and attractive, the methodological requirements were met, for the most part, on a macrocycle extended to one calendar year, given that most training programmes propose much smaller stages. The thesis goes beyond the description phase, present and necessary in the preliminary research, by explaining the athletes' behaviour based on experimental evidence that aims to reveal the cause-effect relationship.

Sports training methodology is a vast field, but in what concerns mid-life endurance runners, it is limited, although exploration is ongoing. Even less documented in the literature is the training methodology used by amateur master athletes at this age. Given the existence of various training models and debates about periodization, controversies about the consequences of effort volume, effort intensity on the performance and health of athletes, we opted for the hierarchical linear model of training in the basic research. The existing studies are not consistent on the most effective way to combine training volume (km/week) and intensity distribution (% of HRmax or VO₂max).

The methodological requirements of implementing the training programme were not difficult to comply with, according to the statements of the athletes, although the duration of the plan is equal to a calendar year. The most important training indicators targeted by PAsm-12 were effort volume and intensity:

- in the preparatory period (PP), October-January, a volume of 160 km was proposed in the PFG and a volume of 194.00 ± 32.18 in the PFS, the athletes having to run between 40 and 46 km per week, four times a week, at an average microcycle intensity of up to 70% of HR max;
- in the pre-competition period (PPC), February-March, a higher running volume was proposed, of 238.8 ± 11.03 km, that is between 36 km and 64.8 km per week, with a frequency of five sessions per week, the average intensity per microcycle oscillating between 65% and 82% of the sporting

possibilities. The proposed microcycles contained two interval runs each, and the end-of-the-week training included a 21 km run;

- during the competition period (PC), April-September 1/2, the proposed effort volume was 270.92 ± 108.11 km, the sportswomen having to run between 42 km and 67 km per week, at an average of intensity per microcycle between 68% and 85% of HR max;
- during the transition period (PT-September 1/2) a volume of 29 km was proposed, at an average effort intensity per week between 70 and 77% of the max. HR.

The field checks consisted in both weekend group training and in verifications on the effectiveness of the annual physical training programme. The last test, which also represented a performance criterion, took place in natural competition conditions, requiring in addition to motor skills and adequate motivation also the adjustment of the level of competitive stress. The laboratory tests served as elements of the pre-test and post-test in the experiment, helping to establish the structure, objectives and contents of the mesocycles, leading to the improvement, through individualization, of the periodization, as well as to the verification of the hypotheses. Thus, the sportswomen trained in the recommended heart rate zones, constantly checking the heart rate measured by the smart watch during training. Performance diagnostic tests, together with the feedback provided by smart technology watches, provided a clearer and more accurate overview of their own performance level, helping female athletes to maintain or improve this level.

In the case of the six participating sportswomen, we cannot speak of a spectacular performance evolution, but of maintaining their fitness and preserving the satisfaction generated by endurance running, as shown by the results of the satisfaction questionnaire applied in the post-test, after the end of the macrocycle.

The results of the athletes participating in this competition are strong evidence of the effectiveness of the PAsm-12 by comparison with other athletes, but also with previous personal performances. Participation in competitions continued even after this last test through freely chosen races, at different distances, road or mountain runs, which indicate the physical and psychological availability of the athletes, their ability to adapt to various conditions.

We consider the internal validity of the experiment in the basic research to be high. Placing the experimental intervention in the natural life setting of the participants made it difficult to control the factors that explain the results, but we appreciate that it represents a success through the greater ecological value. The ecological validity of the results also guarantees the easier generalization of this training programme on other groups of half-marathoners. To this end, we described the independent variable (PAsm-12) in sufficient detail to allow replication of the experiment and tested several hypotheses so as to cover as much of the changes in the dependent variables as possible.

We tried to ensure, throughout the research, a good quality of the investigative approach. The results of the two preliminary studies can be generalized with some caution, due to the small number of participants, their recruitment being marked by social distancing from 2020-2022. In addition, in Romania, participation in the marathon is numerically smaller compared to other countries and diminishes the possibility of recruiting respondents for data collection. These studies can be replicated in larger groups by improving investigation tools. Also, the use of the Wellbeing Scale in shortened form, although it has acceptable psychometric qualities, does not guarantee the

correctness of comparisons with other research. In future studies, it can be replaced with the original version, possibly adapted for the population of our country. The same improvement process can be applied to other tools used, the validation of the scales indicating the aspects that are useful to be changed.

The basic research was challenging, with the experimental method having major difficulties in design, application and analysis. Running the training plan over 12 mesocycles involved an effort to develop and control the factors that can influence the final results and an effort to faithfully implement it by the participants. Participating in intermediate tests during the experiment and, in particular, participating in real competitions, required efforts to balance it with the professional activity, family obligations or other issues the participants had. We tried to reduce the disadvantage of the small number of participants by approaching their evolution in the manner of case studies, providing numerous details to help explain the results. The initial and final boxes designed symmetrically, but also with the necessary novelty elements, are the embodiment of this way of working.

We believe that both the preliminary studies and the basic research have good validity, they accurately, correctly and completely describe the results to deepen the understanding of the athletic, demographic and psychological factors involved in the practice of endurance running and the achievement of performance. The results suggest recommendations for runners and coaches regarding factors related to maintaining effort during exercise and generating running satisfaction and wellbeing.

Future research directions concern the improvement of research tools and the publication of validation studies in order to insert them into the research circuit. The resumption of some hypotheses, with less precise results, which appear as trends, we believe can be a valuable future contribution. The application, simultaneously with the tools developed by us, of some classic tools, can increase the confidence of the scientific community in the newly created tools and can enrich the data on Romanian athletes, bringing into the literature of the field information from a new social and sporting context. Also, investigating performance factors other than the unique training plan, such as athletes' lifestyle or self-control, can be developments of this thesis.

Novelty elements

The major personal contributions can be grouped as follows:

1. organizing and conducting a mixed research;
2. the development, implementation and experimental validation of a training programme for a one-year macrocycle;
3. the development and validation of several tools to get to know the behaviour and attitudes of Romanian endurance athletes;
4. contributions regarding the enrichment of the specialized literature;
5. In what concerns the organization and conduct of the research, the targeted objectives required the use of a research that combines the quantitative approach (questionnaire-based survey), the experiment and the qualitative research (document study, content analysis).

The experiment, the main method used in the basic research, involved:

- developing the experimental research methodology for the given topic;

- the development of an advisory training plan, structured on 12 mesocycles (PAsm-12), which is, to our knowledge, the first predominately physical training plan for the half-marathon, intended for amateur athletes in Romania, with experience in endurance running;
- the validation of PAsm-12 through a rigorous follow-up of the sportswomen's behaviour and through the verification of several hypotheses that systematically aim at the essential aspects of training;
- the flexibility of the training programme, its suitability to the personality of the sportswomen (sporting past, anthropometric, physiological characteristics), first of all by proposing intervals for the finishing times, consistent with the acceptable limit of the time dedicated to the half-marathon;
- using heart rate as the main indicator for monitoring training intensity, an indicator that is easy to measure and understand by amateur athletes, who do not have in-depth knowledge of anatomy and physiology, etc.
- suggesting some effort intensities expressed as percentages of the maximum heart rate, to respond to the various physiological needs of the female runners. The development, implementation and monitoring of a unique annual physical training programme for adult amateur half-marathon athletes constitute the major personal contribution in the doctoral thesis.
- with regard to the development and validation of some tools for getting to know the behaviour and attitudes of endurance athletes, we mention:
 - the creation of three original tools that can be taken over by other researchers and be inserted the specialized literature, especially after their improvement. These are also adaptable to other sports disciplines/events, with minor modifications. The three tools are:
 - The scale for measuring the consequences of the half-marathon,
 - Running Satisfaction Scale,
 - Unique Annual Training Plan Satisfaction.
 - rigorous validation of the three tools, which indicate good psychometric qualities, which ensures confidence in the results obtained.

The contributions regarding the enrichment of the specialized literature with data on the behaviour of Romanian half-marathoners are the result of the preliminary research, a premise for the basic research. The preliminary studies focused on running motivation, running satisfaction and wellbeing, self-esteem, the consequences of running on the mind and body, particularly important variables in explaining sports performance, present in studies conducted on groups from other countries. The data were processed statistically, complying with the rigors in the field, and were compared with the results of studies already published in the field. The load of articles on the half-marathon, resulting from the collection of data from athletes in Romania, is quite small compared to studies from other countries and probably in accordance with the short history of this sporting event in our country. The experimental results can themselves constitute contributions to the extension of the understanding of the behaviour of adult amateur athletes through tested hypotheses, which use data relevant to the half-marathon.

The investigation of groups of athletes, amateurs and professionals, from Romania and which provides information on the antecedents, management and consequences of running, thus bringing together the three sequences, is a dimension rarely found even in specialized studies worldwide.

The analysis and synthesis of the current state of research on training for the performance of the half-marathon test, in a construction that we wanted to be clear and rigorous, constitutes another contribution to enriching the literature in the field.

We also mention the regression equation calculated to help amateur athletes. Based on the results of the conducted experiment, we provided a means of calculating lactate based on the pulse, by simply replacing personal data in the regression equation, which only involves performing some accessible arithmetic operations. In addition to the theoretical contribution, this fact also constitutes an application of the results in conducting the half-marathon training.

The unique annual physical training plan can become a tool for adult, trained female athletes, but can also be extended to other groups of amateur athletes. This contribution can be amplified by turning this programme into a training guide for endurance running in Romania.

Dissemination

The results of the research carried out within the doctoral thesis were published in three articles, of which one ISI indexed article in a non-impact factor journal and two articles published in BDI journals. All three journals are indexed in more than three recognized international databases. To these is added the presentation of three scientific papers at international conferences, two of which were subsequently published in journals. The articles cover key aspects of the research, such as motivation at two different times of running, effort volume, health issues and ways of recovery, the relationship between performance and times obtained in the laboratory and on the field.

Articles published in BDI journals:

1. **Baba, D. & Balint, L. (2022).** The Training Effort for Master Athletes in Romania in Relation to Self-esteem, *Revista Românească pentru Educație Multidimensională* 14(1), 155-171.
<https://lumenpublishing.com/journals/index.php/rrem/article/view/4732>,
DOI:<https://doi.org/10.18662/rrem/14.1Sup1/543>

The Journal is indexed in Web of Science (WOS); EBSCO; Google Scholar; ICI Journals Master List, Index Copernicus; Ideas RePeC; Econpapers; Socionet; CEEOL; Ulrich ProQuest; Cabell, Journalseek; Scipio; Philpapers; KVK; WorldCat; CrossRef; J-GATE

2. **Baba, D. & Balint, L. (2021).** Health Issues of the Romanian Masters Athletes, the Correlation between the Medical Conditions and the Recoveries. *Bulletin of the Transilvania University of Brasov. Series IX: Sciences of Human Kinetics*, 14(63).
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1. **Baba, D. & Balint, L. (2021).** Motivations of the Training Effort for Romanian Master Athletes, *Discobolul – Physical Education, Sport and Kinetotherapy Journal*, 60 (3), 280-293.
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The Journal is indexed in ERIH PLUS, EBSCO, DOAJ, CROSSREF, CEEOL, Index Copernicus, Directory of Abstract Indexing for Journals (DAIJ), Eurasian Scientific Journal Index (ESJI), J-Gate (Publisher – Informatics India Ltd), SCIPRO (Romanian Editorial Platform), Open Academic Journals Index (OAJI.net) and Google Academic.

Papers presented at scientific conferences in the field:

- Baba, D. & Balint, L. (2021).** Health Issues of the Romanian Masters Athletes, the Correlation between the Medical Conditions and the Recoveries. Scientific paper presented at the *International Scientific Conference Youth in the Perspective of Olympic Movement*, University of Braşov, Mars, 19-20, Braşov, 2021. (Annex 23).
- Baba, D. & Balint, L. (2021).** Motivations of the Training Effort for Romanian Master Athletes. Scientific paper presented at the *International Congress of Education, Health and Human Movement*, Bucharest, June 10-12, 2021. (Annex 24)
- Baba, D. & Balint, L. (2023).** Performance in the field running races and predicted performance in the laboratory. Scientific paper presented at the *16th International Conference in education, sports and health*, May 19, Bucureşti, 2023. (Annex 25).

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THESIS SUMMARY

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