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ORIGINAL RESEARCH PAPER

On the practical experiences of the long-term athlete development programme of Hungarian swimming

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ABSTRACT

The success of Hungarian swimming is underpinned by a preparation and competition system that has been developed for many years, thanks to the professional group of the sports federation and the scientific and practical work of professionals in the sport. In our study, we aim to present the experiences of recent years regarding the domestic application of the Long-Term Athlete Development Program (LTAD) for swimmers. Our results indicate that there are several discrepancies between the application of the LTAD model for Hungarian swimmers and the expected theory. We believe that the success of Hungarian swimmers is partly due to maintaining the basic principles of the LTAD model and comparing it with other nations' swimming preparation plans, working within a system that includes unique elements to ensure the success of this small country.

KEYWORDS

Hungary, swimming, LTAD, talent management

INTRODUCTION

To increase participation in sports, reduce the loss of talents, and support longer-term staying in sports, increasing attention is directed towards programs targeting the youth age group. Currently, the Long-Term Athlete Development Program (LTAD) dominates the literature on this topic, focusing on appropriate loads by age group and gender, monitoring physiological parameters, adapting and continuously evaluating them. The goal is to enable athletes to move to the next level without the negative consequences of early specialization, such as injury and dropout. Originally designed by Balyi [1] for the Canadian Olympic alpine skiing team, the model has been adopted by several nations into their own systems, such as England [2], Australia [3], and has also appeared in other sports such as ice hockey [4], volleyball [5], swimming [6], and judo [7].

In swimming, several major swimming nations have their development programs, all of which have adopted some principles of the LTAD. Thus our country, as a centre of World Aquatics, could not lag behind them and it was important to have a unified and directive training system.

The LTAD program developed for Hungarian swimmers also divides preparation into seven stages. In the first six stages, the training of competitors is under the control of the Hungarian Swimming Federation's professional group and encompasses the age groups of the Hungarian Swimming Federation (HSF) competition system. The Active start stage (4–6 years) is the period of learning to swim when children do not yet compete officially. From the second stage onwards, they become age-group competitors. The Fundamentals stage includes

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the frog and dolphin age groups (7–10 years), the Learn to Train stage the shark age group (11–12 years), the Train to Train stage the child age group (13–14 years), and the Train to Compete (15–16 years) encompasses adolescent swimmers (see Fig. 1). The first three stages aim to increase the basis of youth swimming and to foster a love for the sport, supported by the 'Swimming Nation and Every Child Should Learn to Swim' federal programs. From the third stage onwards, achieving results becomes increasingly important, and the Champion of the Future Program provides opportunities for talented children to excel. In the Train to Compete and Train to Win stages, swimmers strive to reach the peak of their careers with the help of the Junior and the Hungarian National Team frameworks.

In recent years, several studies have focused on the practical application of the LTAD. In most cases, this has been measured primarily through reports [8]. Frankish and colleagues [9] describe coaches as being receptive to the implementation of the model, however, the realization is hindered by the structure of clubs and differing coach philosophies. Telegdi [10] believes that it is necessary to reinforce the effective integration of the model into practice at federation level. Banack and colleagues [2], as well as Costa and colleagues [11], have pointed out that integrating key elements of the LTAD model into training is only possible above a certain level of coaching knowledge. Algar and colleagues [12] believe that many coaches do not feel competent enough for this. Other articles highlight issues with the sport-specific elements of the model. In the practical application of swimming, it has been noticed that overemphasizing the model in training negatively affects technical execution. Competition rules also differ from the LTAD guidelines, and early specialization is incompatible with the model's recommendations [13]. Greyson and colleagues [14] consider that the correct application of the LTAD for potential sprinters is an impractical path. Additionally, the scope of training is criticized in several age categories.

It still seems that there is no consensus on the most effective development plan, thus further research is necessary in this area [15]. In our research, we were curious about how the most important guidelines of the LTAD model (structuring of training, competition system, different ages, and genders) are reflected in domestic practice and what unique characteristics the model's applicability has in our country. We recommend to use our results alongside domestic and international sports literature, as well as domestic teaching and coaching literature.

METHODS

In our data collection, we used document analysis, a common method in social science research. We reviewed several nations' LTAD models for swimming, as well as articles/papers about their practical applicability. In addition, we utilized scientific writings examining Hungarian swimming, studies prepared by coaches, and the training materials, competition announcements, and regulations of the HSF for data analysis.

RESULTS

When we compared the practice of LTAD for Hungarian swimmers, to other nations' models, we found the following characteristics.

Active start (4–6 years) – learning to swim

The first training phase for swimmers typically begins at the ages of 4–6, when children are capable of participating in

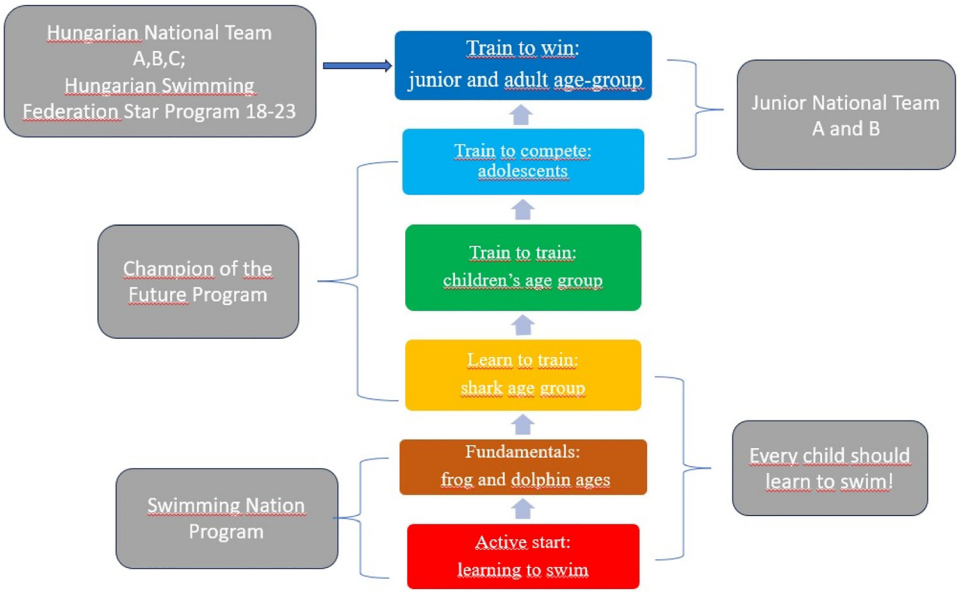


Fig. 1. The long-term athlete development program for Hungarian swimming

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group-based motion teaching. Water activities earlier in life do not form an integral part of the Hungarian system, although there is an opportunity for participation in the so-called baby swimming. During this phase, the aim is to foster a love for the sport and to develop a body-cultural education. The swimming instructor must perform precise work to ensure that children attending swimming classes receive solid foundations for modern competitive techniques and integration into the training and competition system, or potentially move into other water sports (such as water polo, kayak, triathlon, synchronized swimming, etc.). It is necessary to teach swimming students to be able to preserve their physical integrity and be engaged in water-related leisure activities [16]. To acquire this body-cultural educational content, the sporty lifestyle of the family and environment mentioned by Géczi and Balyi [17] is not sufficient; a properly trained sports professional needs to handle the children's training.

Similarly to other nations' swimming LTAD models [3, 18], the first emphasis should be on acclimatization to water. The domestic practice additionally assigns a significant role to the technical execution of gliding on the stomach and back according to specific criteria, followed by mastering the basic techniques of the four swimming strokes [19].

In the Canadian swimming model, a daily, at least 60-min session is the expectation [18]. In our country, participation 2–3 times a week is necessary to maintain the continuity of the learning process. Those children who already know they want to compete, are grouped separately, and the number of swimming instruction sessions increases to 4–5 times a week. For prospective competitors, beyond mastering the basic technique, the technical execution of dives, regular turns and finishes are also required [20]. At this stage of Hungarian swimmers' training, dryland preparation appears as an additional element compared to other models. The preparatory and introductory practices during the training process are supplemented by balance and rhythm-developing exercises [16, 20].

In the first LTAD stage, competitions are rarely mentioned. In addition to smaller competitions held during instructional hours, children participate in club/school internal competitions to provide prospective swimmers with a sense of achievement and a positive orientation towards physical activity, primarily swimming. It is also a Hungarian speciality that during this stage, children prepare for the Hungarian Swimming Federation's Professional Basic Requirements Examination [21, 22]. This professional exam ensures that well-prepared children start at competitions. This entry requirement into competitive sports raises the level of training for youth competitive swimmers.

Fundamentals (7–10 years) – frog and dolphin age groups

According to the LTAD model, Hungarian swimmers enter the Fundamentals phase from the age of 7. Interestingly, in the training of Canadian and Australian swimmers, girls are categorized in this phase from the age of 5 [3, 18]. The main goal is to perfect the basic techniques of the four swimming strokes, start developing modern competitive techniques, master the competition rules, and get acquainted with the fifth swimming style, the medley. Coaches need to focus on developing water sensitivity and agility, maintaining diverse and stimulating training sessions, and ensuring that 70–80% of training involves technique improvement exercises. Children learn several new technical elements [23], including underwater work specific to each stroke and practice starts. At this point, our swimmers' technical training is advanced compared to other models, as it covers the technical requirements of turns and underwater work for each stroke, as well as the precise and high-quality execution of glides after push-offs [19]. According to the model's recommendations, attending training sessions is not yet mandatory, and many engage in other sports alongside swimming. However, by the end of this phase, the volume of training increases so much that if the family is considering competitive activity, it becomes necessary to choose a sport. Especially since, in this phase, the swimmers' training sessions are longer than in other swimming models. Instead of 60-min, 90 to 120-min-long training sessions characterize the preparation, and dryland skill development is also a part of general training. From a competition point of view, a slightly higher standard is expected of Hungarian swimmers by the end of this stage compared to other swimming nations, as they participate in regional championships besides in-house practice meets, where they need to meet qualifying times. In recent years, however, there has been progress in Hungary, with the youngest age group championships being divided into smaller regions [24]. This division helps to avoid the overload and pressure caused by the compulsion for results, fulfils the recommendations related to relative age in Hungarian youth training [25–27], and provides more children with the opportunity to experience success, thus easing their staying in the sport.

Learn to train (11–12 years) – shark age group

The main goal during this period is to familiarize and master various training methods, coupled with high-level technical training for aerobic capacity development [23]. Coaches keep a mixed-type preparation in mind in line with the LTAD model when planning the athletes' training, as it develops them across a broad spectrum and encourages swimmers to gain experience in different swimming styles and competition distances [28]. As mentioned in the LTAD model, this stage makes the athlete's movement more harmonious and economical [17], so technique-improving drills continue to be a prominent part of training tasks, as well as increasing time spent on starts, turns, and underwater work [29].

Daily training attendance, including Saturdays, is a basic requirement for domestic swimmers aged 10–12. Morning sessions are introduced into long-term preparation with introductory objectives, thus the number of training sessions changes to 6–7 per week. The Canadian swimming model also features a similar number of training sessions, but the

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duration of each session is shorter, not reaching 120 min [18]. Consequently, Hungarian swimmers do not have the opportunity to engage in other sports, as suggested by the LTAD model [30]. The main focus of dryland skill development at this time is creating the conditioning background necessary for executing modern competitive techniques. This involves the development of core and leg muscles involved in swimming through bodyweight strength training, as well as joint mobility and flexibility, which receive heightened attention in Hungarian practice compared to other nations. Other models do not mention this, but in Hungary, shoulder preventive exercises also begin with bands, preparing for the greater loads and physical changes of puberty [20, 23]. In other models, competition appears at this stage [3, 18], but domestic practice moves to a more advanced level. Instead of a two-day, timed regional championship, a four-day preliminary-final competition format is used. Furthermore, the evaluation becomes national. This change in the competition system contradicts the recommendations of the LTAD model, as Hungarian swimmers thus become acquainted with the competitive swimming system around the age of 11, while the model only deems this necessary in the next stage [17]. To maintain success experiences and motivation, the final fields are determined by year of birth, and championship placements are also announced by year of birth. Canadian swimmers are advised to measure aerobic capabilities, ideally under competition conditions [18]. This is also possible in the domestic competition system by participating in the National Long Distance Swimming Championships, where competitors start in the same 1,500 m freestyle as in the National Shark Swimming Championships [21, 31].

Train to train (13–14 years) – children age group

Contrary to the theoretical LTAD model and its practical implementation in other nations, in this phase, domestic swimmers spend only two years instead of four. During this period, in addition to aerobic development, the initiation of anaerobic capacity development is crucial, as well as beginning to form the swimmer's own stroke and competitive distance by the end of the stage [28]. Although the formation of an individual style is not yet recommended at this time [18], it starts for Hungarian swimmers and unfolds in the next stage. Technique improvement, monitoring of starts, turns, and underwater work in terms of strength and speed, and enhancing the time spent underwater remain focal points during training.

The number of weekly training sessions can be increased to 7–8, including 2-3 morning sessions, every weekday afternoon, and Saturday morning [30]. During dryland sessions, coaches begin developing endurance with light weights. Strengthening the core and leg muscles remains a priority, while the development of the arm and shoulder muscles involved in swimming becomes an integral part of the training during this period. Suggestions for stabilizing the shoulder, elbow, spine, and ankle are noted for this stage [18], but Hungarian swimmers are already ahead as they started this in the previous phase and are now building upon that foundation to start strength development. Exercises that promote joint mobility and flexibility, similar to those read in previous studies [3, 18], are part of the dryland training every training day [23]. A new element in the competition system is the introduction of the National Short Course Age Group Swimming Championships, responding to recent changes in the international sports scene. With the international emergence of short course races, it became necessary to introduce this type of competition at the domestic junior level as well, to ensure that Hungarian swimmers can keep pace with the international field both in junior and adult categories.

Train to compete (boys 15–16 years) - adolescent age group

This training phase also lasts for two years in the case of Hungarian swimmers. In the LTAD model, the Train to Compete phase lasts much longer, up to age 21 for girls and 23 for boys. In other nations' LTAD models, the maximum age is 18, considering the international trends in swimming and based on practical experience, this phase cannot last longer. The main goal is specialization, determining which events and distances a swimmer can be most successful in. Thus, beyond the recommendations of the LTAD model and in line with other swimming models [3, 18], it is necessary not only to repeat technical elements but also to adjust them to individual characteristics.

In terms of training methods, as the end of the period approaches, swimmers begin to learn the fundamental elements of a "Three-macrocycle training system" and start their preparation using it [23], which is still used today by Hungarian adult swimmers at world competitions [32]. The specific Hungarian preparation system in this phase integrates into the long-term training program, which requires well-constructed, cumulative work from previous stages.

During this period, swimmers have 10 swimming practices and 3–5 dryland skill development sessions per week. The strength development part of the dryland work becomes dominant, considering the biological maturity emphasized by the model. Swimmers mostly work with small and large weights, resistance bands, and various other aids. Special attention is directed towards joint mobility and flexibility training, and facilitate recovery processes [23], as recommended by the training strategies of Australian and Canadian swimmers during this period. A significant difference in terms of competition compared to earlier phases is that finals are organized by age group rather than by year of birth, and evaluations are also separated accordingly. This is the first age group where the Hungarian Swimming Federation (HSF) has introduced an international evaluation system. There is an opportunity at the National Championships for Adolescents for a so-called up-competition, allowing younger swimmers who meet the qualifying times to compete. As the LTAD model emphasizes, results already

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matter at this stage. The best adolescent-age swimmers, as members of the Hungarian Adolescent National Team, can participate in two international competitions. Thus, international competitions also begin for Hungarian swimmers in this phase [21, 31].

Train to win (boys 17 years and older) – youth and adult age group

The goal of this phase is to maximize skills and abilities to achieve peak performance and to unfold the swimmer's talent. This is the last station in the career of an age-group athlete, which also marks the transition into the adult age group [33]. Hungarian swimmers enter this phase two years earlier than the model suggests for both genders, a practice common in other nations as well. The phase starts early but lasts long, potentially into their early thirties. Utilizing the "Three-macrocycle training system" developed by Tamás Széchy, Hungarian swimmers prepare by blending Hungarian traditions with innovations born from international competitive requirements [32]. Specific training in energy systems is the main focus.

Swimmers are given flexibility regarding the structure of their preparation. Thus, some train in teams, in smaller or larger elite sports club groups, while others train alone or in pairs, forming smaller teams. The number and duration of training sessions are determined by the specific preparation for individual events [32]. Preparation for competitions focuses on the Summer Olympic Games, held every four years, as a central element [32]. Youth athletes often have the opportunity to gain experience in domestic and international competitions for adults. Upon entering the adult age group, first, the Olympics, and the World and European Championships (25 and 50 m) become the most important goals [21, 31]. The ratio of training to competition suggested by the LTAD model (25–75%) can currently be approached by participating in the World Cup series. Although the HSF tries to improve the competitive opportunities for youth and adult swimmers, it currently does not meet the necessary quality and quantity. There are multiple competition opportunities in the country, however, the fields mostly consist of age-group athletes, thus not reaching the level that would encourage development in swimmers who make it to the national team. Participation in the mentioned World Cup series is voluntary but must be coordinated with the team's international competitions. Strengthening this area is seen as one of the developmental opportunities for Hungarian swimming. The European Swimming Federation (LEN) introduced the U23 age group into its competition system for the first time in 2023. This internationally organized age group competition could provide a more continuous transition between the youth and adult categories, where typically most athletes quit high-level sports. We believe that this decision could be a good alternative to the American college competition system, as similar international competitions are expected to emerge in the long run, and this might shift the onset of high-volume training. This could also help the Hungarian National Team in transitioning a higher proportion of the successes achieved at the Youth European Championships into adult achievements [34].

Activity for life (25 years and older) - recreational swimming, senior age group

This stage can be entered from any age group following the rapid growth phase but is primarily indicative in the period following a competitive career. It includes various paths depending on when one joins. For those swimmers who cannot spend the majority of their days preparing but wish to stay close to the sport and remain active as part of a healthy lifestyle, there is an opportunity to enter the senior competition system. The LTAD model refers to this path as "Competition for Life" [17]. Many sports clubs offer senior swimming training and organize senior competitions. The main focus of the "Fitness for Life" direction [17] is health preservation, thus characterized by unstructured sports activities. In Hungary, this often represents a transition from competitive sports to recreational sports. There are also opportunities for training in sports clubs or attending swimming sessions for adults. The "Sport and Physical Activity Leadership" direction serves as a kind of talent transfer, aiming to retain talented individuals in sports [33]. This is quite common in Hungary. The majority of students at Hungary's largest sports university, the Hungarian University of Sports Science, were previously involved in competitive sports daily and continue to be involved in sports. Thus, upon concluding an active sporting career, there is an excellent opportunity to employ the experiences gained as an athlete in service of future sports participating in teaching, coaching, management, and other sports science fields. It appears that this stage is well-developed for Hungarian swimmers and provides a variety of meaningful opportunities to stay connected to the sport.

CONCLUSIONS

Since 2013, the Hungarian Swimming Long-Term Athlete Development Program has induced significant progress through a phased implementation. The competition system has changed for the youngest age groups, especially in terms of the organization and evaluation of their main annual competitions, to eliminate the previously prevalent choice between results and technique in Hungary, as mentioned by Lang and Light [13, 23]. The use of age-based evaluations and regional championships alleviates the pressure for results, allowing technical training to be maintained at a high level as expected by the model. At older age groups, the possibility of "racing up" has been restricted to prevent rapid advancements and the pursuit thereof [21], targeting also the prevention of overtraining, burnout, and early specialization. The effectiveness of these measures requires ongoing studies to enhance the application of the LTAD model.

The HSF's Featured Sports Development Program (2013–2023) has launched several unprecedented youth and talent development programs for its athletes [35]. These

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programs aim to establish the foundational principles shown in the LTAD model and provide all necessary support to enable the implementation of open-mindedness and paradigm shifts in swim coaching and teaching, as mentioned by Géczi and Balyi [17]. Support arrives within the first two LTAD phases through two programs supported by the sports federation (see Fig. 1). The "Every Child Should Learn to Swim" and "Swimming Nation Program" provide opportunities for youth swimming instruction regardless of location, age, gender, or financial situation. New clubs are forming in previously peripheral areas, and clubs with decades of experience in swimming instruction can now serve even larger numbers of children with quality education. In the Hungarian system, supported programs form the basis of youth swimming development, whereas, for example, the Canadian swimming model [18] can only rely on organizations related to swimming instruction (school swimming lessons, swim schools). Bridging the gap between swimming instruction and competitive swimming remains an ongoing task for the sports federation, which also stimulates the continuation of our research.

In the Learn to Train, Train to Train and Train to Compete stages, the "Champion of Future" talent development program adds value to the long-term training system, ensuring a higher level of preparation for Hungarian swimmers. Besides financial support, the training plan based on age-specific characteristics and the best coaches' experiences offers additional opportunities for the development of age-group swimmers. Important in the funding of national team frameworks are the new "Heracles Star" program and the Youth "A" and "B" national teams, which help bridge the challenging transition between youth and adult stages. Essentially, the top-ranked swimmers aged 13–16 and those up to 23 years who have proven themselves in international age-group competitions get additional chances to catch up to the adult elite. Practically, this support manifests in domestic and international training camps and international competition opportunities. Further progress is expected following the first U23 European Championships in the program [35]. In line with the Canadian swimming LTAD model, we believe that the success of these programs could be crucial for applying the LTAD model principles in the long-term preparation of Hungarian swimmers.

For the success of the LTAD model, coaches' skills and knowledge are essential [18]. Agreeing with Nelson and Cushion [36], the training of domestic coaches has significantly changed. Only those with a license issued by HSF, renewed every two years, can teach swimming or act as swimming coaches. Several conferences are organized annually to collect points and acquire up-to-date knowledge. During and after the COVID-19 pandemic period, HSF's knowledge base expanded by 80 presentations [37]. Although the study of the practical implementation of the Portuguese Swimming Federation's LTAD model [11] showed that coaches' knowledge and experience only partially influenced the model's practical implementation, we believe that the mandatory training and continuing education of Hungarian coaches at federation level are essential for the model's effectiveness in practice. Additionally, we are pleased that a sports science group has been established in collaboration with Semmelweis University, aimed at covering all specialities that serve the development of elite sports [35]. The registration and continuing education of coaches, instructors, and referees received a new IT platform and regulations, which came into effect on September 1, 2023.

Our research aimed to present the practical application of the LTAD model in Hungarian swimming. The examination of the program fills a gap in both international and domestic literature. In our opinion, the practical realization of the Hungarian swimming LTAD model is satisfactory, and the innovations presented are well-suited to local conditions and effectively complement the LTAD principles. The effectiveness of the system built over the past years is continuously proven by the performance of Hungarian swimmers in both the youth and adult categories. The presence of skilled and more motivated coaches, a more modern training environment, and talent development programs demonstrably result in higher motivation, a more task-oriented training environment, the presence of flow experience, and lower levels of burnout in the youth age group [8]. However, it raises the question of how the programs created by HSF will influence the implementation of the swimmers' LTAD model over time. The intention seems to be in the right direction, but examining the consequences prompts further research. Our further plan is to assess the practical implementation of the presented aspects more broadly. As development goes beyond physical and technical skills, our goal is also to summarize the characteristics of Hungarian swimming from a psychological perspective, with a detailed overview of the activities of the Featured Sports Development program.

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