Athletics for Children and Adolescents

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by Jürgen Schiffer

AUTHOR

Jürgen Schiffer, PhD, is the Vice-Director of the Central Library of the German Sport University in Cologne and the Documentation Editor of NSA.

Introduction

How athletics serves and develops young people is critical for the future of the sport. Success in the area of talent development will impact performances at all levels and the quality of the future's elite stars, who are essential for attention and support required for athletics to thrive. But the quality of the experience children and adolescents have in athletics is also important, because those who do not go on to become top performers are the number one source of the audiences, volunteers and supporters, and positive memories are great tools for keeping people close and engaged with the sport.

Responsibility in this area is shared among the sport's leaders, coaches, teachers and others who need to be aware of a wide ranging set of issues touching the realms of physiology, psychology, training science, sociology and others.

The aim of this article is to provide an overview of the most prominent positions and informed thinking on the most important of these issues drawn from the current literature. The main points to be covered are:

- Developmental and Physical Characteristics
- Physiological Adaptations to Exercise and Training,
- Ranges of Sensitivity,
- Differences Between the Sexes,
- The Talent Problem,
- Training Issues,
- Strength Training,
- The Dropout Problem,
- Competition.

Developmental and Physical Characteristics of Children and Adolescents[1]

Anthropometric differences between children and adults

Children have different proportions and composition than adults. They have relatively larger heads, shorter extremities, and smaller torsos than adults. Compared to an adult, the younger the child is, the greater the difference in proportion (Malina, 1984). At birth, the head is about 25% of total body length while for an adult the head is about 12% of the total body length. Similarly, adult leg length accounts for at least half of the total height; at birth, the legs are about 30% of total body length. The extremities grow faster than the torso which grows faster than the head. This means that, based on their short legs and large heads, tasks such as balancing and jumping are very difficult for young children (BUNS, 2011).

Muscle mass

Muscle mass increases steadily along with weight gain from birth through adolescence. In males, the skeletal muscle mass increases from 25% of total body weight at birth to about 40-45% or more in young men. Much of this gain occurs when the muscle development rate peaks at puberty. This peak corresponds to a sudden, almost 10-fold increase in testosterone production. In girls there is not such a sharp increase in muscle mass. Their muscle mass does continue to increase, although more slowly than boys', to about 30-35% of their total body weight as young adults. This rate difference is largely attributed to hormonal differences at puberty. In both boys and girls, muscle mass increases result primarily from fiber hypertrophy (increase in the size of muscle fibres) with little or no hyperplasia (increase in the number of muscle fibres). Muscle mass peaks in girls between ages 16 and 20 and in boys between ages 18 and 25, although it can be further increased through exercise and/or diet.

Balance, agility, coordination, strength, and running speed

As children grow, they develop better balance, agility and coordination as their nervous systems develop. Myelination, i.e., the process by which a fatty layer, called myelin, accumulates around nerve cells, must be completed before fast reactions and skilled movement can occur because conduction of an impulse along a nerve fibre is considerably slower if myelination is absent or incomplete.

Strength improves as muscle mass increases with age. Gains in strength with growth also depend on neural maturation because neuromuscular control is limited until myelination is complete, usually around sexual maturity. Peak strength is usually attained by age 20 in women and between ages 20 and 30 in men. The hormonal changes that accompany puberty lead to marked increases in strength in pubescent males because of the increased muscle mass noted above. Girls, on the other hand, experience a more gradual increase in strength and do not exhibit any marked change relative to to body weight after puberty.

Running speed increases during childhood because of stride length increases. The stride increases as the legs grow longer and stronger and as the pattern becomes more efficient. As children progress, they take longer strides and stay in the air longer during the flight phase. When young children are asked to run faster, they generally take quicker steps – often in place. Rather than saying "Run faster," coaches should therefore say, "take bigger steps."

The fastest runners use their arms to pull themselves forward. The arms move in opposition, with the upper arm (humerus) driving forward forcefully. In young children, the arms may be stationary or may flail in no particular pattern. As skill increases, the arms begin to rotate in opposition, but this movement is generated by a twisting of the spine rather than by conscious movement of the humerus.

Skills change systematically for children from two years of age through elementary school. For example, a 2-year-old runs with arms high, extended, and straight, feet shoulder-width apart, and a short, flat-footed step whereas this kind of movement cannot be seen in an adolescent or an adult (BUNS, 2011).

Cardiovascular, respiratory, metabolic, and thermoregulatory function

During both submaximal and maximal exercise, a child's smaller heart and blood volume result in a lower stroke volume than in adults. In partial compensation, a child's heart rate is higher than an adult's for the same exercise intensity. But even with increased heart rate, a child's cardiac output remains less than an adult's. In submaximal exercise, an increase in arterial-mixed venous oxygen difference ensures adequate oxygen delivery to the active muscles. But at maximal work rates, oxygen delivery limits performance in activities other than those in which the child merely needs to move his or her body mass, such as in running.

Lung volume increases until physical maturity, primarily because of increasing body size. Until physical maturity, maximal ventilatory capacity and maximal expiratory ventilation in-

crease in direct proportion to the increase in body size during maximal exercise.

Like pulmonary and cardiovascular function, aerobic capacity improves with continued physical development. VO_2max peaks between ages 17 and 21 years in males and between 12 and 15 years in women, after which it steadily decreases. The child's lower VO_2max value (L/min) limits endurance performance unless body weight is the major resistance to movement, such as in distance running. When expressed relative to body weight, a child's VO_2max is similar to an adult's, yet in activities such as distance running, a child's performance is far inferior to adult performance. Also, running economy is lower in children compared with adults, when VO_2 is expressed relative to body weight. This difference can be explained by the difference between children and adults in stride frequency for the same fixed-pace run.

Children's ability to perform anaerobic activities is even more limited. A child has a lower glycolytic capacity, possibly because of a limited amount of phosphofruktokinase or lactate dehydrogenase. Children have lower lactate concentrations in both blood and muscle at maximal and supramaximal rates of work. Children cannot attain high respiratory exchange ratios during maximal or exhaustive exercise, suggesting less lactate production. Anaerobic mean and peak power outputs are lower in children than in adults, even when scaled for body mass.

Children also have a lower hemoglobin concentration in the blood than adults. Hemoglobin is the part of blood that carries oxygen to the working muscles (e.g., in the heart and legs), so children transport less oxygen per unit of blood than adults. This means that children can do less work than adults. Hemoglobin content in the blood increases at puberty; however, the increase is not as great in women as it is in men (BUNS, 2011).

Laboratory studies suggest that children are more susceptible to injury or illness from thermal stress because they have a greater ratio of body surface area to mass when compared to adults. They are capable of less evaporative heat loss than adults because they sweat less. Heat acclimatization is also slower in children than in adults. In cold environments children are at a greater risk of hypothermia because they have greater conductive heat loss than adults.

Physiological Adaptations to Exercise and Training[2]

Body composition changes with training in children and adolescents are similar to those seen in adults: loss of total body weight and fat mass and increase in fat-free mass. Resistance training during childhood and adolescence can lead to stronger, broader and denser bones. Strength gains achieved from resistance training in children result primarily from improved motor skill coordination, increased motor unit activation, and other neurological adaptations. Unlike adults, children experience little change in muscle size from strength training.

Although the endurance performance of children improves with aerobic training, such kind of training does not alter VO_2max as much as would be expected for the training stimulus, possibly because VO_2max depends on heart size.

In spite of their lower ability to perform anaerobic activities, children's anaerobic capacity increases with anaerobic training.

Ranges of Sensitivity

Motor ability generally increases for the first 18 years of life. However, in girls it tends to plateau around puberty. This plateau can probably be attributed to increased estrogen levels, which promote greater fat deposition, and less muscle mass.

Awareness of age ranges sensitivity for the development of certain physical performance factors assists in obtaining best training results. Based on a study to establish the most suitable periods for the development of strength, power and speed capacities for boys and girls in the 10-18 years age range, LOKO et al. (1996) arrive at the following conclusions:

- The sensitive period for the development of static strength occurs in the 13-16 years age range for boys with the largest increase (23.4%) taking place between 14-15 years The most sensitive period for girls is in the 11-13 years age range with 39.7% of the total improvement.
- The most sensitive development of leg power for boys takes place in the 12-17 years age range with the best results recorded between 13 and 16 years. In girls, the most sensitive period occurs from 10-12 years. During these two years (10-11 and 11-12), the standing long jump shows an improvement of 81.8%, the vertical jump 77.2% of the total achieved during seven years.
- The most sensitive period for arm power development for boys is in the age between 13 and 17 years, while the girls record their best results in the 10-13 years age range.
- The sensitive period for the development of running speed for boys falls within the range of 12-17 years, while girls achieve best results during the early ages of 10-13 years.

In general, the sensitive periods to develop various physical performance capacities are concentrated in the 12-17 years age range for boys and 10-13 years age range for girls.

The Difference between Boys and Girls

Although the bodies of girls and boys are more alike than different during childhood, differences emerge during puberty that give males a performance advantage in certain activities. At puberty, or about the 12-13 years of age range, the growth of girls slows dramatically and then stops completely at about 15-16 years of age. Males reach puberty about two years later than girls and therefore reach their adult size at about 17-19 years of age, thus growing two years longer than girls (MALINA, 1984).

Prior to puberty, boys and girls are very similar in height and weight although in elementary school the earliest maturing girls are likely to be taller than everyone else. This means when grouping athletes, children of similar skill should work together because it can be safer and motivations for success peaks when the challenge is appropriate.

As far as, for example, running speed is concerned, the average running speed for girls and boys is nearly the same during elementary school. Girls demonstrate the mature running form at a slightly earlier age than boys; most children demonstrate a mature form by seven years of age. At puberty, boys continue to increase running speed, whereas girls' running speed tends to level off or decreases slightly.

The differences during elementary school are attributed to different treatment of boys and girls. For example, boys tend to have great opportunity, expectation, and encouragement, but there is no biological reason to expect differences during elementary school. Therefore coaches need to provide equal opportunity, have similar expectations, and encourage boys and girls equally.

Respiration response is the same for girls and boys. As children train, respiration rate can provide information about level of fatigue. For example, a child who can talk easily while jogging is probably breathing steadily; when respiration interferes with talking, the child is moving toward fatigue.

The Talent Problem

In his article review of the current state of affairs concerning what talent is and how it can be best discovered and developed, TRANCKLE (2004) points to the absence of a widely recognised definition of talent. Nevertheless, attempts have been made to make things clearer. For example, talent has been used to describe the raw material as well as the end product of a developmental process. This has led to the proposal of a distinction between between raw materials and the end product. This resulted in decribing the raw material as "giftedness" and defining it as "the possession and use of untrained and spontaneously expressed natural abilities (called aptitude or gifts), in at least one ability domain,

to a degree that places a child at least among the top 10% of his or her age peers" (GAGNE as cited by TRANCKLE, 2004).

At the other end of the spectrum, the end product of a developmental process has been described as 'talent', which has been defined as "the superior mastery of systematically developed abilities (or skills) and knowledge in at least one field of human activity to a degree that places a child's achievement within at least the upper 10% of age peers who are actively in that field or fields" (GAGNE as cited by TRANCKLE, 2004).

However, definitions are less interesting for sport theorists and coaches than the question how talent can be maximised in the lives of performers. So the sport community concentrates on talent detection (= the discovery of potential performers who are currently not involved in the sport in question), talent identification (= the process of recognising current participants with the potential to become elite athletes), and talent development (= the provision of performers with a suitable learning environment so that they have the opportunity to realise their potential) (TRANCKLE, 2004).

Among coaches, there is the widespread opinion that scientifically valid methods for talent detection do not exist and that as an alternative it is coaches' judgements that are the best solution for detecting and identifying talent.

The following statement by KOZEL (as cited by TRANCKLE, 2004) can be regarded as a summary of the currently predominating view concerning the talent problem: "Talent is an extremely complex attribute; genetically determined, complicated in structure and subject to environmental conditions. It is for this reason that there is no consensus of opinion, nationally or internationally, regarding the theory and methodology of talent identification, selection and training in sport […]. Generally, it is still the coach's eye and expert's judgment which is decisive in the talent screening and selection process."

As far as talent development is concerned, the following stages can be differentiated (COTE, 1999, as cited by TRANCKLE, 2004):

- The "sampling years" typically take place between the ages of six and 13 years. During this time, children experience fun and excitement through a range of extra-curricular activities. These activities can also be called "deliberate play", which can be characterised as being voluntary, pleasurable, providing immediate gratification and developing intrinsic motivation.
- During the "specialising years" children tend to narrow the focus of their involvement. This stage usually occurs between the ages of 13 and 15. Although fun and excitement remain as central elements in the children's participation, there is a growing importance placed on sport-specific skill development.
- During the "investment years", which begin at about the age of 15, there is more importance placed on strategic, competitive and skill development aspects of sport, along with an extremely intense commitment and tremendous amounts of practice.
- The investment years (until about the age of 18 years) are followed by the "maintenance years", which involve the perfection and maintenance of talent, developed during the investment years.

A slightly different model of talent development is presented by DEMPSTER (2005):

- The FUNdamental phase (chronological age: 8-12, training age: 0): This phase is characterised by FUN and participation first and foremost. No formal training sessions are carried out.
- The "training to train" phase (chronological age: 13-16, training age: 1-4): The focus in this phase is to start to gradually introduce the concept of training as opposed to playing. FUN is still involved, but the activities are structured and presented in more of a "real session".
- The "training to win" phase (chronological age: 21-24, training age: 9-12): In this phase everything is geared towards performance. The capacity to be able to handle

a heavy training schedule should be attained by this phase but full capacity in this area has not yet been reached.

According to this model, up until the athlete's mid-twenties he or she is still in a development phase.

A very important factor in talent development is the influence of the teacher or coach. However, it is very rare for the same teacher or coach to progress an individual through all phases of talent development because of the different requirements at each stage of talent development. This has implications for athletes being encouraged to move on to different coaches as they advance and thus require more specialist or expert guidance (TRANCKLE, 2004).

In addition to the influence of teachers in the development of talent, a greater influence during childhood comes from the family. Talented individuals often come from so-called "complex families," that are both integrated and differentiated. "Integrated" refers to the stable conditions among family members whereby the children feel a sense of support and consistency. "Differentiated" refers to the notion that members of the family are encouraged to develop their individuality by seeking out new challenges and opportunities (CSIKSZENTMIHALYI et al., 1996).

OGILVIE (1981) deals with the question how parents can play a wholesome supportive role in the life of the aspiring child. In Ogilvie's opinion, the ideal would be that the parent should be a guest in the life of the child. This would permit the child to remain in control and invite the parent to share whatever they might be experiencing based upon their personal need. The child competitor should be in control of his or her own life and have total responsibility for valuing the experience in personal terms.

Training Issues

As outlined above, children differ from adults in many of their body responses to hard physical activity and they are not just 'little adults' physiologically (JONES, 1993). Children are adequately equipped to handle activities that require short but intensive exertion (phosphagen system) or more prolonged periods of moderate exertion (aerobic system). They are not well equipped to cope with training that demands a significant contribution from the lactacid system. Training of the lactacid system should therefore be refrained from until after the peak of the growth spurt has been reached. Similarly, children are responsive to muscular endurance training but work with heavy weights should be avoided until puberty is complete.

Training regimes introduced at the appropriate time in the child's development will induce favourable changes in the child's physiology of a similar magnitude to those expected in adults. A period of detraining will cause many of these changes to gradually decay. There is no strong evidence to support the suggestion that training must be started early in order to experience success as an adult and early specialisation is counterproductive. Coaches need to be sensitive to the fact that childhood is often linked to the rate of maturation – early maturing boys have a distinct advantage in most sports but with girls it is often the late maturers who are successful. Children should be encouraged to internalise the motivation to exercise so that when the extrinsic motivation of the coach is removed they are not "turned off" (ARMSTRONG, 1992).

According to DICK (1980), fundamental to long-term development of competition performance is that the athlete has a sound technical model upon which to build, against a background of basic general strength, mobility and endurance. That is why the development of a sound technical model must have priority in coaching the young athlete (8-15 years for girls and 8-17 years for boys). The ranges permit exposure to a multiplicity of techniques from 8-11 years (girls) and 8-13 years (boys), followed by a period for stabilising specialised techniques. Implicit in this is that competitive success is not a priority at this juncture of the athlete's development.

GAMBETTA (1986) also holds that the first experience in athletics for the beginning athlete should emphasise the basics to provide a sound foundation for further progress and development.

Since the training aim of young athletes is to prepare for the best possible performances when they reach the adult age, the correct approach to training during the years of growth appears to be most important to secure future success. Although some fluctuations occur, it is possible to divide the training progress of young athletes into the following four stages: 1. play training (7-10 years); 2. basic training (11-13 years); 3. constructive training (14-16 years); 4. specific training (from 17 years) (JURISMA, 1980).

It is absolutely essential that coaches are aware of the pitfalls of specialisation too soon (ARENS, 1983). Early specialisation, by its very nature treats children as little adults (JONES, 1993).

Studies conducted by LOKTYEVIN & MAKAROVA (1993) revealed that many young athletes failed to lift their performances to an improved level after suffering from extreme competition loads. This was particularly noticeable among the talented youngsters who often decided to retire after a couple of seasons of exhaustive racing loads. The authors (1993) arrive at the conclusion that competitions at a young age should not be rigorous and harsh tests, but only special occasions to enjoy movement without extreme emphasis on winning. Keeping sporting activities fun and varied when young is essential, the hard specific training starts when the athlete is fully matured and that can vary immensely from child to child (LOWES, 2005). MARKUS (1976) is also of the opinion that the age between 13 and 18 should be used to learn new skills and to have fun. He foresees serious problems if an intensive, specialised training is introduced during the 12-16 age period.

According to MCSTRAVICK (1990), the following points should be borne in mind when considering both the content and the strategy of athletics coaching with school-age children:

- provide an enjoyable experience for participants,
- provide a programme,
- programming must be geared towards success,
- the importance of play.

It is vital that competition for school age children be arranged so that all pupils have a positive experience. Late developers must not be placed in a situation where early developers will so dominate the competition that it becomes an unpleasant experience. MCSTRAVICK (1990) recommends group/team competitions and combined event competitions (where performance is related to score) because they provide excellent opportunities to stress self-improvement rather than winning and losing.

Strength Training

The pros and cons of strength training for children and adolescents have been a very up-to-date topic during recent years. For a long time physicians and physiologists were convinced that weight training did not produce significant strength gains in prepubescents (DUDA, 1986). Insufficient circulating androgens in children were considered as the predominant restriction to strength gains. Additionally, safety concerns regarding bone integrity, epiphyseal continuity and risk of injury have been common.

Although even in recent articles, the opinion is held that in prepubescent children the time might better be spent doing something else than weight training (BUNS, 2011), most newer investigations support significant strength gains in prepubescents as a result of weight training. Further, based on recent findings of short-term prepubertal weight training, no damage to bone, epiphyses, growth tissue, or muscle has been reported (JACOBSON & KULLING, 1989). The risk of injury also ap-

pears low during participation in a resistance training programme, and this risk is minimised with proper supervision and instruction. Furthermore, with the incidence of injury in youth sports, participation in a resistance training programme may provide a protective advantage in one's preparation for sports participation (KRAEMER et al., 1989).

OLTMANNS & ZAWIEJA (2011) sum up the current state of knowledge on the topic of "strength training for children" in three main points: 1. Strength training with children is possible and worthwhile. 2. It is safe if properly conducted. 3 It is an essential part of training from both the point of view of health and performance.

Nevertheless, according to KRAEMER et al. (1989), resistance training prescription in younger populations requires certain programme variables to be altered from adult perspectives. Individualisation is vital, as the rate of physiological maturation has an impact on the adaptations that occur. The major difference in programmes for children is the use of lighter loads (i.e., > 6 RM loads). It appears that longer duration programmes (i.e., 10-20 weeks) are better for observing training adaptations. This may be due to the fact that it takes more exercise to stimulate adaptational mechanisms related to strength performance beyond that of normal growth rates.

The Dropout Problem

Young athletes must not only be identified and developed but they must also be retained. For example, in the USA, 35% of the participants in children's sports programmes withdraw each year. While some move to other sports, others drop out altogether (RIEWALD, 2003). The prevention of dropout is therefore also an important task of athletics organisations.

BUSSMANN (1999) defines dropouts as those athletes who have terminated their athletic career prematurely, i. e. before they have reached their top performance. She identifies the following factors as decisive for the termination of one's career – and vice versa – for continuing one's competitive career: stresses and strains at school and work, injuries, missing free time, conflicts in the athletic environment: with coaches, club, the training group and officials, lack of support by the family, missing or inadequate motivation, low social mobility, a critical attitude toward competitive sport. According to BUSSMANN, the risk of dropout can be minimised by:

- including the conditions outside sport (such as school and job/professional education) in the planning of the individual career,
- supporting the athlete in the process of overcoming an injury,
- discussing and solving conflicts between the competitive sport activity and leisure-time activities,
- a socially supportive and harmonious climate in the club and training group,
- ensuring that the athlete is supported by his or her familiy,
- ensuring that the athlete's coaches have a basic knowledge of performance motivation in general and of their respective athlete's motivation in particular,
- supporting the athlete's social mobility and attitude toward competitive sport.

Ideas on how parents can play a wholesome supportive role in the life of the aspiring child are provided by OGILVIE (1981). In Ogilvie's opinion, the ideal would be that the parent should be a guest in the life of the child. This would permit the child to remain in control and invite the parent to share whatever they might be experiencing based upon their personal need. The child competitor should be in control of his or her own life and have total responsibility for valuing the experience in personal terms.

In addition to the dropout reducing factors listed by BUSSMANN, LEE & OWEN (1984) point out that dropout can also be reduced by promoting fun and intrinsic interest as well as setting individual goals.

RIEWALD (2003) places particular emphasis on the fun factor and lists the following strategies to incorporate fun into the youth athletics environment:

- bring more relays to youth athletics,
- structure multidiscipline competitions, i. e., each athlete competes in a throwing, jumping and running event,
- allow for or create opportunities to interact with friends,
- as a coach, know the athlete as people,
- communicate/provide feedback to each athlete on a regular basis,
- be creative with scoring so that many experience the positive feelings of success.

The incorporation of "fun" in athletics means that athletics for children requires moderations (FREY, 1992). A proportionate athletics programme for students should be many-sided and supported by motivational psychology. The training volume, training frequency and the number of competitions should not be simply a scaled down copy of training programmes for adults. A variety of different situations makes participation in athletics more attractive and can therefore reduce the number of dropouts.

The British concept of Fun in Athletics has been made particularly attractive by moving the competitions, which take place in autumn, winter and spring, indoors. This makes it possible to provide a different environment for the novel events, conducted as a team competition. Emphasis in fun competitions is placed on a team effort, creating a need for all team members to play their part, even when they have to line up events that are not among their favourites. This approach assists in avoiding early specialisation. Although certain competition rules are applied to the fun events, disqualifications are avoided as far as possible in order to have all performances acknowledged (BUSSE, et al., 1998).

Kid's Athletics is a team athletics programme that has been developed by the IAAF to avoid early specialisation and events are therefore not scale models of adults' competitions. It is based on three age groupings: Group 1 – children 7-8 years; Group 2 – children 9-10 years; Group 3 – children 11-12 years. Teams are mixed and generally comprise 10 members and most events are conducted in some relay format. Events are sprinting and running, throwing and jumping. Scoring is designed to keep the event outcome unpredictable and give participants a feeling that they can actually win the event they participate in. The programme that was developed was based on meeting the following requirements: a) to offer children attractive athletics; b) to offer children accessible athletics; c) to offer children instructive athletics. Kid's Athletics is intended to bring excitement into playing athletics. The most important objectives are:

- that a large number of children can be active at the same time,
- that varied and basic athletic forms of movement are experienced,
- that not only stronger or faster children make a contribution to a good result (WEST, 2009).

Competitions for children and youths (including performance development aspects)

On the international level there are the following athletics championships:

- the IAAF World Junior Championships for Athletics, for athletes of 18 or 19 years on 31st December in the year of competition, held biennially since 1986,
- the IAAF World Youth Championships in Athletics, for competitors who are 17 or younger, held biennially since 1999,
- the European Athletics Junior Championships, first held in 1970, held biennially since 1973,
- the European Athletics U23 Championships, for athletes under 23 years of age, held biennially since 1997,
- the Youth Olympic Games (YOG), held every four years for athletes between 14 to 18 years of age, first held in Singapore from 14 to 26 August 2010 and to be held for the second time in 2014 in Nanjing (China).

The introduction of international championships for young athletes has not met with unanimous agreement. For example, in a roundtable discussion dealing with the 1st World Youth Championships (CHIMIER et al. 2000), it was pointed out that the main danger in staging the WYCA is that some coaches and young athletes start to specialise in just one event or their training only focuses on the improvement of performance at all costs in order to get good results in the championships. This could lead to many problems that could hinder the development of these athletes in the future. It was recommended that the IAAF should limit the age of the athlete to 16-17, athletes who are younger should not be allowed to enter the championships.

This aspect of international championships for young athletes is also taken up in a very interesting article by BAUMANN & MALLOW (1998). In their analysis of the performance situation in German junior middle and long distance running they arrive at the conclusion that in Germany junior middle and long distance runners train extremely hard without, however, showing correspondingly improved performances in their senior years. According to the authors, the cause of this is, besides a too early concentration on running training and the neglect of under- and over-distance competitions and cross-country races, the fact that today's ambitious juniors all aim to take part in the European and World Junior Championships. In the seventies and eighties, when German distance runners were more successful, World Junior Championships did not exist, cross-country racing used to be regarded as a must for middle-distance runners, and a wide approach to performance development meant racing in over- and under-distance competitions. Fartlek used to be very popular among the former German distance runners, who trained a lot on undulated cross-country trails. This promoted the natural development of the important factor of strength endurance. In general, the early training years of the former German elite distance runners were characterised by a refreshing simplicity. They learned early how to guide themselves and how to deal flexibly with the training plan. Because of this naturalness, combined with spontaneity, training was an uncomplicated and therefore enjoyable activity.

However, the rather negative point of view expressed by BAUMANN & MALLOW concerning German distance running is not shared by SCHOLZ (2006), who conducted an analysis of the throwing events at the IAAF World Junior Championships. He arrives at the conclusion that the IAAF World Junior Championships are a springboard for entry into the elite class. He even states that for the future it can be assumed that athletes without international experiences in the Junior category will only in exceptional cases be successful in big events (e. g. in World Indoor Championships, World Championships, Olympic Games). Experiences as well as statistics confirm that for the "young stars" the World Junior Championships are an interim station. However, winning a title is no guarantee for victory at the Olympic Games or World Championships.

The results of a study of the performance development of the finalists at the 1999 IAAF World Youth Championships conducted by GRUND & RITZDORF (2006) are comparable to the results of SCHOLZ' study. GRUND & RITZDORF found, among other things, that 90% of the finalists (n= 266) at the first WYC continued to improve in the subsequent years and 88% made the world top 100 in their best disciplines. They conclude that as 21% of the group qualified for the IAAF World Championships in Athletics and/or the Olympic Games between 2000 and 2004, there is no basis on this point for rejecting international youth championships as a valuable element of the world competition calendar.

According to DIGEL (2008), the decision to create a Youth Olympic Games, with the first edition held in Singapore in 2010, creates opportunities for the International Olympic Committee (IOC) and the international sport federations to promote positive values in a

sustainable way. However, he also points out that the organisation and staging of the Games entails serious risks of creating unintended and undesirable side effects that could threaten the success of the event or even lead to the self-destruction of the current sports system. For example, each strengthening of a big global sport event like the Olympic Games inevitably leads to a reduction of interest in the individual sports they comprise. For some time already it has been possible to see that the existence of some Olympic sports is dependent on the financial aid coming from the IOC. This problematic development would be accelerated by the introduction of the Youth Olympic Games. For many sports, the Youth Olympic Games cannot, or can only to a very limited extent be justified on the basis of training theory, medical and developmental-psychological reasons. An Olympic competition inescapably leads to athletes preparing for such Games with enormous amounts of intense training. This will lead to an earlier age of high performance in most of the Olympic sports, which contradicts the scientific consensus on the ideal for long-term development. According to this consensus, early specialisation should be avoided in almost all Olympic sports. In view of the doping problem, which affects most of the sports intensively, a trend towards top performances at an earlier age would be fatal. In some sports there is even the danger that performances achieved by youths would be better than those of adults. The effect would be a depreciation of the adult Olympic medals, which cannot be in the interest of the IOC. Against this background, DIGEL recommends that the organisers find creative concepts to address the issues raised and that research be conducted so that lessons for preparation of future editions can be learned.

Please send all correspondence to:

Dr Jürgen Schiffer

j.schiffer@dshs-koeln.de

FOOTNOTES

Page 9: If not otherwise indicated, the statements in this chapter are based on Kenney, Wilmore and Costill (2012, pp. 428-443).

Page 11: The statements in this chapter are based on Kenney Wilmore and Costill (2012, pp. 440).

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