EARLY SPORT SPECIALIZATION: HOW AND WHEN TO EVALUATE BODY BUILD AND COMPOSITION PREDISPOSED TO SPORT ACHIEVEMENT

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ABSTRACT

Children and youth are encouraged to select sport disciplines at ages younger than ever before. Body size, build, and composition indicate sport predispositions, but they change during childhood and adolescence. Somatic and physiological characteristics are strongly determined by genetic factors; however, during growth processes they present adaptational changes. The important matter is to connect the epigenetic impact with gene expressions. However, it is not obvious whether the response of the organism to exercise training has a positive consequence. Prior to adolescence, sex differences in the intensity of growth processes and motor skill development are minor. Adolescence starts earlier in girls (aged 10–11 years) than in boys (approximately 2 years later). During this time, boys gain more in height, weight, muscle mass and strength, and it is not possible for girls to compete against them in most sports. At the period of intensive growth of the long bones, the threat of injury should exclude youth from participation in collision sports. Sport success is closely related to maturity; therefore, identification of early- and late-maturing athletes is very important. Late-maturing individuals, at the same chronological age as early-maturing individuals, will face undue risk of injury due to slower and longer growth of bones and muscles. Once identified as an individual who is maturing more rapidly or more slowly, the child should have opportunity to compete against young athletes who are of similar maturity, not the same chronological age. Therefore, non-invasive indicators of maturity status should be established.

The consequence of “the fashion for sport” is that children and youth are encouraged to choose a sport specialization and train systematically at a young age. The goal is to then perform a feat and join the sports elite. Literature mentions a few aims of a good sports program for youth: (1) deriving pleasure from doing sports; (2) mastering sports rules and strategy; (3) increasing physical activity; (4) forming social bonds, developing self-esteem, and making friends; (5) learning sports conduct and rules of fair play; (6) building the habit of regularly engaging in physical activity; and (7) preventing obesity [1].

Body build (physique), especially some of its proportions and composition (the relative amounts of bone, muscle, and fat that make up body mass), is immensely important for sports performance. Papers distinguish constitution types (somatotypes) characterizing general build and tissue proportions. Somatotype, however, is not a guarantee of success or failure, but creates favorable conditions for success in certain sports disciplines. This is true especially when individuals develop the somatotype useful in a given discipline.

With this in mind, we can help children choose a sport most suited for their body builds. However, this is only one predisposing element. Because body build is genetically determined, it practically does not undergo any changes. It is also difficult to determine body type during childhood, especially in the maturation period [2]. For sports performance, body elements (tissue components), i.e., appropriate proportions of bone, muscle and fat mass, are of greater significance:
Fat percentage (% FM) and fat-free mass (FFM) are especially important. Nevertheless, success in sport is influenced by many biological and mental factors. First and foremost, it is influenced by physical fitness, motor skills, overall and particular sports abilities, coach’s skills, and quality of training. Success also depends on cognitive, mental, and social factors [3].

Among the discussed body build characteristics, the proportions of longitudinal elements of limbs in relation to each other and in relation to the trunk (namely, the system of levers) are very important in many sports disciplines. However, physical build, which determines sports performance, undergoes constant changes during childhood and adolescence. The role of muscles, which generate strength, is of major importance. The more strength and power an athlete has, the greater chance he/she has in achieving success against a competitor. Fat tissue, as an excessive load, is a factor impeding an athlete. A considerable amount of fat decreases speed and reduces endurance. It also increases risk of injury in some sports. In all sports disciplines except sumo and wrestling, top athletes try to be slim, muscular, and have a minimal amount of fat tissue [4].

**Genetic and environmental determinants of sports performance**

Knowledge of ontogeny, including growth (increase of body size and mass), differentiation (formation of proportions in size and components) and maturation (functional improvement), helps to choose a sports discipline most suitable for a given age and sex that will not disturb this genetically determined and hormone-controlled process. Body build (shape and components) are unique for every individual, just as the related physiological functions are. Monozygotic twins are an exception, but slight differences also exist between them due to epigenetic processes. The abovementioned traits are strongly dependent on own genes (genotype), but they undergo alterations during growth. They are sex-specific and change due to age, environment, and lifestyle. For these reasons, selecting individuals suited for different sports disciplines is necessary.

All traits of body build are strongly determined (conditioned) genetically; most of them are influenced by numerous genes. For example, body height is ultimately affected by approximately 180 genes inherited from parents. This explains the belief that great athletes “are born” not “made”. Nevertheless, the reality of these genetic predispositions is determined by opportunities presented by the environment (both natural and man-made) as well as lifestyle. This also concerns training.

Body structure, composition and their mutual proportions, especially pattern of fat tissue distribution (including potential abdomen obesity), bone density, and joint structure are not the only traits determined by genetic factors. Strength and endurance fitness depend on muscle type and its development. Agility, balance, coordination, and movement speed depend mostly on nervous system. Strength capacity and maximal aerobic capacity depend on the development of respiratory and circulatory systems as well as on cardiac size and function. Therefore, genetics concern the functioning of the whole body, including physiological traits and psychomotor performance. Moreover, force capacity is stronger genetically determined than rest capacity. Human physical performance is the result of relation between genetic background, environmental conditions and lifestyle, including training. It is influenced by over 200 autosomal gene variants and quantitative trait loci. The chances of having a perfect sporting genotype are lower than 1 in 20 million. The number of related polymorphisms increases; at the same time, however, their simultaneous occurrence in individuals decreases [5].

Despite numerous studies undertaken in recent decades studying the influence of genetic factors on sport performance, the state of such knowledge remains poor. Research into the relationship of sports and genetics faces many obstacles, mainly due to the small number of persons (elite athletes) and genes that seem to be of key importance in this subject matter [5].

The concept of individual response to training and trainability was undertaken 3 decades ago by a group of American scientists led by Claude Bouchard. Many studies on twins confirmed the strong genetic determination of the organism’s response to training. The studies mainly concerned maximal oxygen uptake, which indicates the level of endurance fitness – a very important peculiarity for good sports achievements. Extensive genetic research that included favorable alleles related to 21 SNP confirmed identification of low and high response to training in people leading sedentary lifestyles [6].

According to somatic and physiological traits that are of prime significance to sports performance, special attention should be paid to genetic control of the following: skeletal muscles and their function; body shape and proportions; and heart and lung anatomy and function. Moreover, resilience should also be taken into consideration.
Several genes were identified as being potentially responsible for trainability of cardiorespiratory traits (including cardiac action) and a skeletal muscles performance [7]. The genes usually mentioned in sports genomics are the following: ACE, ACTN3 ("sports gene"), PRARGC1A, HIF1A, NOS3, and NRF-2 (in particular, their polymorphism).

Apart from the phenomenon of polymorphism, it is very important to associate sports results with epigenetic influences, i.e., biochemical regulators (switches) that have primary control over the expression of individual genes. Three structures of switches characterized by different mechanisms of action have been currently distinguished: (1) methyl groups (CH₃ bound mainly to the ring of cytosine) that are deposited directly on the DNA and silence the genes attached by the DNA methyltransferase; (2) chemical changes in proteins (histones), around which the DNA winds, and as a result, its entire fragments become readable. DNA methylation and histone modifications are strongly linked to each other; (3) MicroRNA (miRNA) responsible for preventing mRNA from being translated into proteins [8]. The miRNA binds to mRNA (during translation period) and, through interference, blocks the synthesis of some polypeptides [9]. It seems that during endurance training, the production of certain types of miRNA that block such genes as RUNX1, SOX9, and PAX3 was smaller. Individual variability in resistance to muscle mass increase due to training, which was connected to the amount of the 3 types of miRNA has been also reported. For example, the quantity of miR-451 was higher only in persons resistant to the training [7].

Regarding epigenetic mechanisms: depending on whether or not the promoter of the ACE gene undergoes methylation, the epigenetic regulation can be more important than the polymorphism itself [10]. Possessing a polymorphism of the ACE gene that is correlated with good sports performance will be insignificant for an athlete if the gene is not expressed.

Epigenetic processes are closely related to environmental factors and probably even emotions. One of these factors, and possibly the most important one, is diet, which influences body build and functions (including physiological processes), health, and physical activity. Nevertheless, we know today that emotions can also modify human development through epigenetic regulation. In addition to eating habits, environmental factors include biogeographical conditions (i.e., natural modifiers) and socioeconomic conditions (i.e., cultural modifiers) ([11, 12, 13]). Within cultural modifiers, family conditions (parental education and income, lifestyle, and eating habits) as well as (system of values, traditions, and social habits are considered as very important cultural modifiers). They form genetically controlled growth processes to varying degrees [14, 15].

**Physical growth patterns**

The most rapid growth can be observed during infancy, which is followed by a period when different systems and organs adjust to greater body mass and when growth decelerates. During the first year an infant grows...
approximately 25 cm. At the age of 6–7 years, there is a slight increase in the growth rate. This is called the "mid growth spurt" (determined by the secretion of adrenal hormones). During the prepubertal period (from 6–7 to 10–12 years), growth rate decreases again, and we can observe intense hormonal changes prior to sexual maturation (puberty). Polish terminology has been adjusted to the terms used in English: the Polish terms "pokwitanie" (puberty) and "dorastanie" (postpuberty) are called adolescence (Figure 1).

During childhood the rate of growth varies slightly for each sex (boys are not much taller than girls, girls mature earlier). Another period of rapid growth rate, called the "pubertal spurt," can usually be observed in girls aged 11–12 years (in some girls, between the ages of 10–13 years); during this time, they are taller than boys (Figure 2). The situation changes after about 2 years, when boys enter puberty period. During pubertal spurt, over 2 to 4 years, the individual grows around 20 cm. The period of sexual maturation (puberty) is followed by a postpuberty period.

A comparison of boys and girls maturation, shown in the figure 3, is arranged by chronological age. Peak

![Figure 2. Periods of progressive ontogenetic development of humans on the basis of height increase velocity according to sex [16].](image)

![Figure 3. Occurrence of peak height velocity (PHC - point zero) and symptoms of sexual maturation observed before and after PHC. Abbreviations: NAH – activation of neurohormonal activity of hypothalamus; LH- secretion of luteinizing hormone; T – testosterone; B – stages of breasts development (B2 – initial stage, and B5 – final stage); PH – stages of pubic hair development (PH2 – initial stage, and PH5 – final stage); G – stages of development of sexual organs (G2 – initial stage, and G5 – stage of full development) [15].](image)
height velocity, which usually occurs about 2 years earlier in girls than in boys, is considered to be the reference point. The charts illustrate the differential timing and rate of changes in both sexes associated with pubertal phase (e.g., hypothalamus activity and development of secondary sexual characteristics). It is a noteworthy fact that the first menstruation in girls (menarche) and the first ejaculation in boys (nocturnal emission) occur at similar chronological ages, i.e., a year preceding peak height velocity in boys, and a year after peak height velocity in girls (Figure 3). Nevertheless, daily increase in body height during the whole period of childhood and youth is irregular and occasional (so called saltations and stasis). A child may grow one day, and then a long stasis, lasting from a few days to a few months, occurs. To date, the factors responsible for this phenomenon have not been fully explained [17, 18, 19].

Development processes and training effort

Physical activity is one of the key factors that not only stimulates physical development, but mental development as well. During childhood and adolescence, regular physical exercise is a crucial environmental factor that allows utilizing a full (genetically determined) developmental potential. Optimal physical exercise involving muscle activity (muscle contraction of optimal intensity stimulates growth plates) affects bone growth in most sports disciplines. However, it has not been explained whether training programs for young athletes have any growth-promoting effect on their height. It is also hard to determine which kind of training is optimal, moderate, or excessive for stimulating growth. First and foremost, there is a competition for elements utilized for growth and development. In boys during puberty, the increase of muscle mass is directly related to intensity and time of training. It is also related to the reduction of fat tissue. However, we know much about how harmful intensive physical activity (exceeding the "acceptable" limit) is for growth processes in young athletes. There is increasing evidence that the growing child's heart responds favorably to physical exertion.

Nevertheless, it is necessary to identify a potential strain regarding cardio-vascular diseases, on the basis of parental health status and history.

There is a lack of research on the influence of intensive, repeated physical exercise (training, competitions) on the skeleton during childhood and early stages of pubertal maturation. The American Academy of Pediatrics' Sports Medicine Committee discourages intense athletic activities, such as long-distance running and weight training, during childhood and until the rapid growth of early adolescence has been completed [4].

The processes of growth and sexual maturation are much more diversified in young athletes than in the average population. There are many early-maturing young athletes and female gymnasts (including ballet) and figure skaters, which are characterized by short stature and late sexual maturation. Nevertheless, we cannot attribute later sexual maturation in athletes to intense training with absolute certainty. It is related instead to the hypothalamo-pituitary function connected with the production of growth hormone (GH), insulin-like growth factor (IGF-1), and gonadal functions, which correspond to each stage of maturation. However, we should be cautious while selecting the best athletes (sport elite), including ballet dancers. Without a doubt, intense training influences growth and sexual maturation. Neither should we disregard genetic and epigenetic factors, which are affected by stress, psychosocial relations, family conditions, eating habits, etc. [20].

The influence of intense training on growth and sexual maturation processes in artistic gymnasts raises concerns. Due to selection, these athletes are characterized by short stature and later maturation. It is arguable whether this is caused by natural predispositions for this sport, or if the intensive training inhibits natural growth. Gymnasts represent pattern of development and maturation similar to the one observed in low-, average-, and late-maturing individuals who were not athletes. According to the literature, adult height of female and male artistic gymnasts is not compromised by intensive gymnastics training. This training does not appear to attenuate growth of upper or lower body segments, and does not appear to attenuate pubertal growth and maturation. Nevertheless, available data are inadequate to address the issue of intensive training and alterations within the endocrine system [21].

Sex differences

Before puberty, sex differences in body composition are small. Boys usually have greater bone and muscle mass and less fat tissue than girls. However, this situation changes drastically during adolescence. After
peak height velocity (11–12 years in girls; 13–15 years in boys), maximal increase of body weight is observed. Boys gain more in height, weight, muscle mass and strength, but less in fat tissue. Girls gain more in fat tissue but less in muscle mass. After puberty, girls have around 66% of boy’s muscle mass, and twice as much fat tissue [15].

There is little difference between sexes in body build and motor skills during childhood, and because of this it is not necessary to separate boys and girls during physical exercise nor to prevent competition between them. The situation completely changes during sexual maturation [22, 23]. Boys are taller, stronger, and have greater body and muscle mass; because of this, girls cannot compete with them in most sports. After age of 11, boys and girls should follow separate competition rules, especially in sports where strength and body size determine efficiency, and which involve a high risk of injury [4].

**Growth plates (metaphyses)**

During maturation, the skeleton first grows in size and length. Then it gains in density and strength (resistant to excessive strain). The long bones of arms and legs increase their length by proliferation of cells located in growth plates at either end of the shaft of long bones (metaphyses). The growth plates are composed of cartilage (soft tissue). As a result, they are the most fragile point in the bone – even weaker than the ligaments that align the neighboring joints. During the period of intensive growth, these plates are particularly prone to damage. Every injury to this area of the bone can destroy the cells responsible for their elongation. Nevertheless, the optimal intensity of alternating pressure (exercises) stimulates ossification. If the exercise intensity is too small, it does not constitute a stimulating factor; if it is too great, it causes damage and consumes too much energy. For fear of such injuries, youth should not engage in collision sports (e.g., American football and wrestling) where severe blows to a leg or arm may be encountered. When growth nears completion in later adolescence, the function of growth plates is finished, and the epiphysis fuses firmly with the shaft of the long bone.

**Individual differences during pubescence**

There is great variation in the age at which individuals experience changes in body structure and basic functions that relate to athletic performance during early years of adolescence. As a result, the age when children are physically ready to perform many kinds of sports disciplines is also different. The identification of early- and late-maturing individuals is therefore very important if they are to be directed into appropriate sport experiences. At the same chronological age, late-maturers will have increased risk of injury due to undeveloped muscles and immature skeleton, and thus, reach a similar physical level late. More importantly, during competition against larger, stronger, and more developed early-maturing peers, they will be less skilled athletes. Difference difference regarding the age of achieving maturity may reach from 4 to 5 years.

**Early-maturing individuals**

Early-maturers are taller, bigger, quicker, acquire sport skills faster, and have more endurance potential than their late-maturing peers at the same chronological age. They are expected to be “school sport stars” among their colleagues. A major problem is that early-maturing individuals enjoy outstanding sport success during school years because of their physical advantage over other students who started training at a later age. Early sports achievements may eliminate chances for success in other areas, e.g., education, various forms of social activity, art, and other types of physical activities (e.g., tourism). Many “young sport stars” experience strong depression after losing their position, which happens often at the age of 16–17 years.

Early-maturing individuals are most probably born to parents who likewise were early maturers; therefore, investigation in this area is necessary. Once the rate of maturation is identified, a child should be given a chance to compete against other individuals at a similar biological, not chronological, age. Early maturers should be aware why their performance is better than others, and their achievements must be compared to these of their biological peers.

**Late-maturing individuals**

Late-maturing individuals are usually small in stature for their age. They reach their final (“adult”) and genetically determined height during and after the peak height velocity. Additionally, they will have less strength, endurance, and skeletal maturity and lower motor skills than their average peers. These individuals will not be able
to compete and achieve good performance in many sports disciplines where results depend on body size, muscle strength, and endurance. In many cases, late maturers will be more prone to injury.

Also in this case, information about the rate of maturation should be obtained from the parents who likewise were late maturers. The identification of the biological (developmental) age is significant to the physical and mental state of late maturers. If early sports participation is important to late-maturing individuals, they should be directed to disciplines that are not primarily dependent on size and strength, i.e. racket sport, diving, and some track events. A late maturer might not become a champion, but she/he will gain certain skills to earn a satisfactory sport position.

Late-maturing individuals should know what maturation is, in which stage of maturation they are, when sports may be beneficial for them, when intensive training will be effective, and when sports participation will bring them satisfaction. It is important for youth aged 14–16 years to avoid negative sport experiences. Late maturers do not have to suffer due to their constant exclusion from sports and denial of related benefits. When appropriately directed (by parents and coaches), it may be them who become sport stars [4].

**New model of an athlete — expectations**

Contemporary athletes are different from those of previous generations. First and foremost, they are bigger and stronger at a younger age [24]. According to the new model, a young athlete is not only characterized by better performance, but also needs better, professional care that involves safety devices, training facilities, coaching, and related regulations. A program in primary schools has to reduce strength and endurance to a minimum. There is no potential for developing these traits at this age. Until the age of 12–13 years, sport should be considered a form of play that allows young individuals to experience various options and introduces them to certain sports techniques, as well as enables the development of appropriate skills (pre-dispositions). Due to changes in the maturing body at the ages of 12–16 years, attention should be paid to the proper selection of individuals competing against each other. Young athletes should be aware of their level of maturity (developmental age) in relation to their chronological age. Youth engaging in sports should not have to suffer from the unrealistic expectations of their coaches and parents [4].

It seems to be true that contemporary young people who choose a sport career strive to be included in the elite, as they expect to reap the social, economic and other benefits associated with success. The majority of young individuals drop out along sport path. A “business” managed by adults is the prime factor causing early sport specialization. There is limited information on effectiveness of early specialization followed by long-lasting success in the chosen discipline. Early success does not guarantee further success among “elite sport”. Moreover, limited experience, usually in only one sport discipline practiced over the entire year, does not favor future success. It is important “to keep sport in perspective” as children and youth engaging in sports (including talented individuals) are first and foremost individuals with needs of children and adolescents, normal for their age. Their primary aim is to “grow up” to future life, both biologically and behaviorally [25].

**Interview, description, and measurements**

The earlier description of growth and maturation phenomena show that the classification of youth as early, average or late maturers for different sport disciplines is of prime importance. Depending on the candidate’s age this information can be obtained in different ways. In prepubertal period (6.5–11.5 years), the suggested method of evaluation involves parents (the rate of growth a highly inheritable trait, thus, analysis of the parent’s development allows us to make predictions about this process in children). This evaluation is, however, a very general one, and only biological parents can be interviewed.

We can distinguish invasive and non-invasive indicators of maturity status [26]. The most popular ones include skeletal age and secondary sexual characteristics (pubic hair, genitals, testicular volume). Skeletal age is applicable from childhood through adolescence, while secondary sex characteristics are limited to pubertal period. However, these methods are regarded as invasive. Skeletal age requires a low dose of radiation and additional costs of conducting the examination (a radiologist, film, and journey to a clinic). Clinical assessment of pubertal status requires direct examination which often involves palpation of genitals to estimate testicular volume, and is considered an “invasion of personal privacy.” Self-assessment of stage of genital and/or pubic hair is a partial solution to this issue. Nevertheless, it is not always accurate, because the
correlation between self and specialist ratings range from 0.59 to 0.92; we can observe both underestimation and overestimation [26].

Due to the aforementioned issues, scientists more often think about perfecting the non-invasive methods, which currently include the following: (1) evaluation of time before or after peak height velocity to estimate the age when it occurs, as well as measurement of current height and sitting height (the difference between these 2 values gives the length of lower limbs), and body mass [27]. (2) Estimating the age at peak height velocity serves for the “model of long-term assessment of athletes” that requires division into early, average and late maturers. A percentage of predicted adult height attained at a given age requires current height and a prediction of adult height. For example, 2 young persons of the same age can have the same height, but one is closer to mature height than the other [26]. For this purpose, we can use a nomogram for predicting the course of development of a given individual (Figure 4).

However, previous studies based on the listed methods conducted with young Portuguese football players showed that non-invasive methods of estimating the maturation age are of limited importance.

In the case of individuals who according to chronological age should be entering or have already begun maturation, interviewing their parents is always necessary. Additionally, we should establish: in girls - the age at first menstruation, which is commonly used to assess the maturation age of whole populations; and in boys – the age at first nocturnal emission, which is rather difficult to determine. Evaluation of secondary sexual characteristics is usually very problematic. In boys, it should be performed by a man, and in girls, by a woman.

Studies have revealed that skeletal age is earlier than chronological age in young football players, while it is later in young female gymnasts [21].

Body composition (BC) is a very popular method, applied in many countries, estimating fat, bone, water and muscle content of the human body. BC undergoes considerable changes during growth, including maturation, and varies a lot between individuals. There are about a dozen methods for evaluating body composition, e.g., impedance, radiographic, and magnetic resonance method. Nevertheless, there are few data available on this subject matter. Most studies concern cross-sectional studies, and they always require a reference group from the same population. [21]. Relative percent of fat (%FM) and of fat-free mass (%FFM) are the 2 most important values obtained through these methods [29,30]. Uncontrolled attempts to reduce fat tissue and increase fat-free mass may lead to eating disorders. The “individuality of each person” should be the prime rule of working with every candidate for an athlete.

Additionally, body measurements of studied children and youth can be applied. The basic longitudinal measurements include height; length of limbs and trunk). Usually, the assessment of body type is based on the Health-Carter method [31, 32]. The evaluation

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Figure 4. Nomogram used for determining the predicted course of a child’s development on the basis of parent’s height [28]
of endomorphy requires measurements of skinfold on arm, under the inferior angle of scapula, and the iliac crest (adjusted to body height). In the case of mesomorphy, it is necessary to measure the largest circumference of the arm and lower leg, as well as the width of the distal epiphysis of humerus (cl-cm) and femur (epl-epm). Ectomorphy is evaluated on the basis of the slenderness index (height divided by the cube root of body mass).

Such features as spine flexibility, grip strength, shoulders strength, and vital capacity should also be considered as potentially important. Individual measurements can be applied to calculate body proportions (e.g., interextremity index, trunk index, upper and lower extremity index) and the BMI and WHR indices (waist circumference to hip circumference). All the aforementioned measurements, together with indices have no meaning in isolation, as they may change with the age of maturing children and youth.

Much worthy for examination is handedness, which allows assessing future development of functional, dynamic, and morphological asymmetry. It seems that measuring body composition, standing stature, spinal curvature, and flat feet during adolescence is of little significance in predicting sport performance. It is, however, important for health protection. Nevertheless, interviewing parents about chronic and congenital diseases in their family is crucial.

For future actions regarding early sport specialization, it is necessary to compare selected candidates for athletes with their local population (regional norms can be useful for this purpose). However, there is a lack of available information on the growth and maturation of young athletes. Comparing body build or predicting future adult height, using data from other countries, which were often established long ago, is highly imprecise, and constitutes malpractice. The comparison of stages of secondary sex characteristics needs to be revised due to the general phenomenon of acceleration of maturation processes.

These are the tasks awaiting Polish human biologists. Currently, it is problematic, but possible, to take measurements of children and youth; however, obtaining additional and reliable information (e.g., socioeconomic status of a family, lifestyle, and eating habits) is extremely difficult due to the typical lack of parents’ permission, even though these studies are anonymous. We believe that educating Polish society is crucial in this regard. The issue not only concerns the future of Polish sport, but also the systematic evaluation of growth processes of all our children and youth.

Discussing early sport specialization, the subject of appropriate growth and health cannot be omitted. For almost 50 years, one of the authors of this paper has been participating in a debate about the role of physical culture and motor fitness. At first, this subject matter was approached holistically, but during the last several decades, the approach has changed according to the accepted paradigm. We can observe that the old topic of sport and health has recently returned in the form of Health-Related Fitness, according to which physical exercise and professional sport should be beneficial for growth and health. The aforementioned tendency is contradictory to early sport specialization. Another controversial subject seen in recent studies concerns “doping” in sport. Perception of the effectiveness of doping should be reconsidered [33]. This should be taken under serious reflection in the context of physical culture in Poland.

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**LITERATURE**


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[31] Carter JEL: The health Carter anthropometric somatotype instruction manual. This revision is adapted from the original instruction manual by the author and a later version published in a CD-Rom titled “Anthropometry Illustrated” (Ross, Carr & Carter, 1999), in association with TeP and ROSSCRAFT, Surrey, Canada, 2002.