LONG-TERM DEVELOPMENT IN THE YOUTH TRAINING PROCESS

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Abstract: *Children and adolescents experience numerous physical changes as a result of growth and maturation. A sensitive period in childhood is an opportunity to encourage the child's development, lay the right foundations and make the most of their potential for growth and development. One of the models of athlete development, LTAD, suggests that during sensitive periods, training should be focused on multifaceted work and improvement of motor skills in children and adolescents. Basketball is a team sport that requires a high level of all motor skills, while speed and agility have proven to be among the most necessary for success in basketball. The goal of the research was to determine the relationship between motor skills and sensitive periods in younger children involved in the basketball training process in order to guide the training process. The sample of respondents were children aged 12 years (+/- 6 months), 21 boys and 20 girls, involved in the basketball training process for six months. The level of motor abilities - general endurance, explosive power, speed and agility was assessed using the following variables: oxygen consumption, standing long jump, standing triple jump, medicine ball throw, 10 m standing start, 20 m standing start, 20 m flying start, backward polygon, figure eight with bending. A statistically significant difference was observed in one test that assessed explosive power (medicine ball throw t-2.19, sig.-0.03) and one test that assessed speed (20 m standing start t— 2.17, sig.-0.03).*
Key words: *training process, sensitive periods, morphological characteristics*

INTRODUCTION

Continuous sports development can be a reflection of the real potential of a young athlete (Milanovic, Jukic, Nakic, & Custonja, 2003). When talking about the training of children and young people, the period between the ages of 6 and 18 is observed, which is divided into three phases based on the developmental characteristics of athletes, sensitive phases, and methodical rules of training work: initiation (ages 6-10), shaping (ages 11-14) and specialization (ages 15-18) (Bompa, 2005).

The entire training program for children should be based on learning through different forms of play with appropriately modified learning and training (Kondric et al., 2010). The critical period and the sensitive period in development refer to certain periods of time during which the individual's ability to learn new skills or acquire certain characteristics is increased, while the sensitive period is similar to the critical period, but it is considered to last longer, and the best-known model of the development of athletes, in which suggested sensitive periods are, is the long-term development model (LTAD) (Balyi et al., 2005). According to this model, long-term development should be based on the improvement of general motor skills - flexibility, speed, technique, endurance and strength according to the suggested sensitive periods based on biological and chronological age for boys and girls (Figure 1).

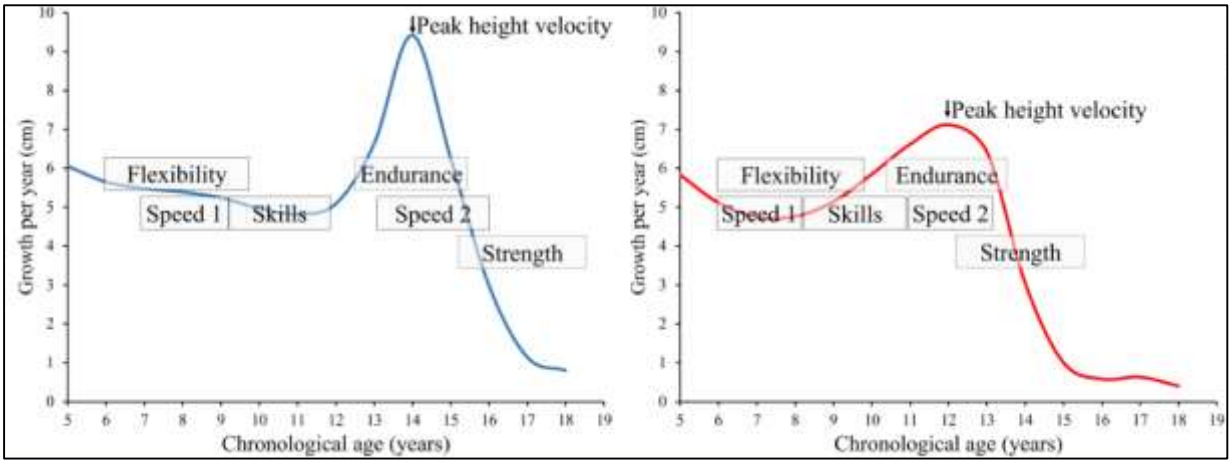


Figure 1 Sensitive periods to train general motor abilities in boys (left) and girls (right) according to the LTAD model (De Ste Croix i Van Hooren, 2020)

As can be seen from the graph, the age periods of 7-9 years and 13-16 years old are suggested as sensitive periods for improving speed in boys, while the sensitive period for improving aerobic capacity is before the phase in which growth is the fastest (PHV). It is assumed that speed training outside these sensitive periods has a reduced effect on performance (De Ste Croix and Van Hooren, 2020). Sensitive periods in the LTAD model (optimal schedule of training, competition and recovery for each stage of sports development) are based on athlete development plans for specific sports, on the practical experience of coaches and empirically tested models of athlete development from the countries of the former Eastern Bloc (Balyi, Cardinal, Higgs , Norris, and Way, 2005; Balyi, Way, and Higgs, 2013). Research on sensitive periods has shown that there is insufficient evidence to suggest that individuals will never reach their genetically maximal motor abilities in adulthood if general motor abilities are not specifically addressed during a hypothetical sensitive period (Ford, Collins, Bailey, MacNamara, Pearce and Toms,2012; Bailey, Collins, Ford, MacNamara, Toms and Pearce, 2010). It was concluded that additional research is needed to determine whether the sensitive periods proposed in the LTAD model really exist, as most of the evidence was based on cross-sectional studies and lower quality intervention studies (Ford et al., 2011). Physical inactivity in childhood negatively affects the functioning of the musculoskeletal system, respiration, blood circulation, digestion and the nervous system (Mannocci et al., 2020; Volmut et al., 2021).

Basketball is a team sport that requires a high level of all motor skills, while speed and agility have been shown to be among the most necessary for success in basketball (Dalextrat, 2009; Karpowicz, 2006; Köklü, 2011).

The aim of the study was to determine the relationships between motor skills and sensitive periods in younger children involved in the basketball training process in order to guide the training process.

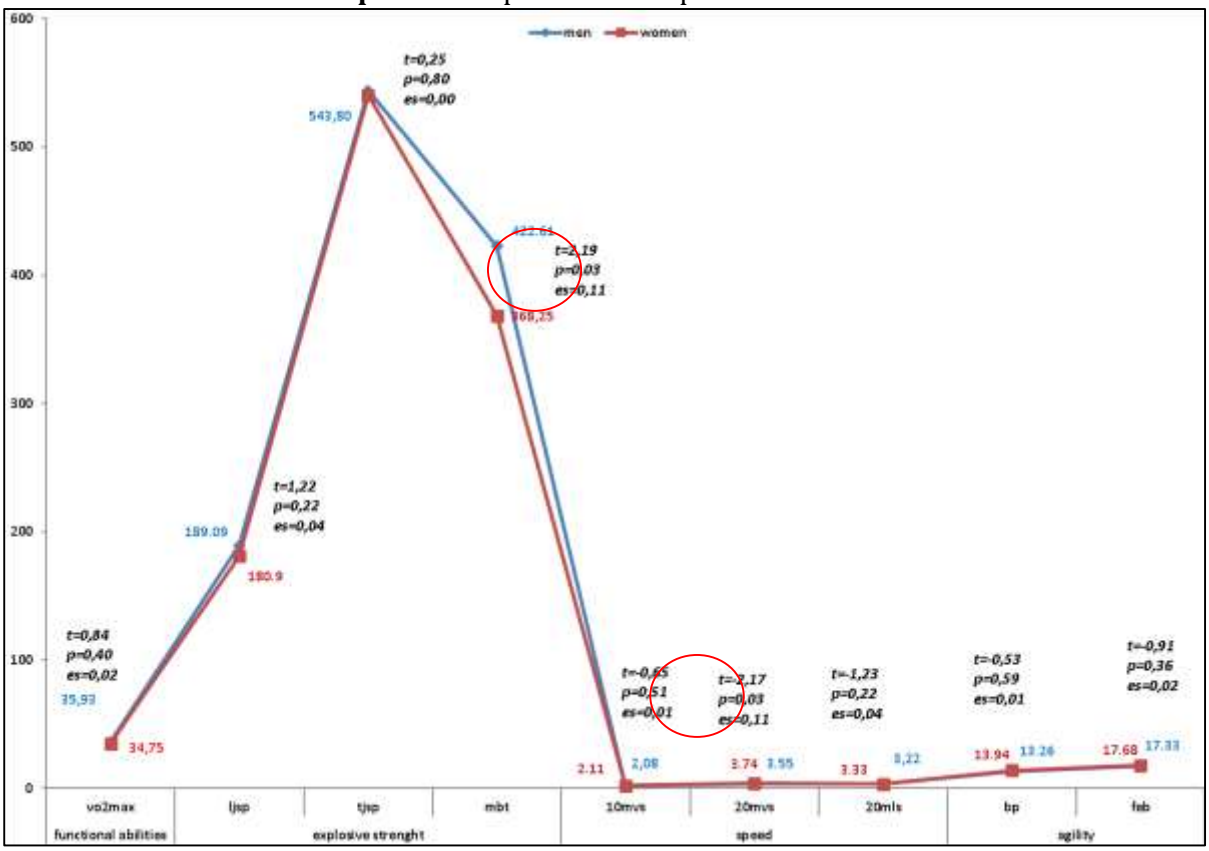
METHODOLOGY

The sample of respondents was 12-year-old children (+/- 6 months), 21 boys and 20 girls, involved in the basketball training process for six months. They were in optimal health and without injuries to the locomotor apparatus. The level of motor abilities - general endurance, explosive strength, speed and agility was assessed using the following variables: oxygen consumption-Beep test (VO^2max), long jump from a standing position (sudalj), triple jump from a standing position (tim), medicine ball throw (bmed), 10 m standing start (10mvs), 20 m standing start (20mvs), 20 m flying start (20mls), backward polygon (ponat), figure eight with bending (oss). The research was transversal in nature, it was conducted over two days, on both days the measurement was performed in the morning according to standardized procedures. On the first day, tests were conducted to determine the level of speed and explosive strength, on the second day, tests were conducted to assess the level of coordination and general endurance.

The data collected during the research were processed using descriptive and comparative statistics, independent T-test. Statistical data processing was performed using the SPSS statistical program (version 20.0).

RESULTS WITH DISCUSSION

Graph 1 Descriptive and comparative statistics



Legend:, VO2max-oxygen consumption, , sudalj-long jump from a standing position, tim-triple jump from a standing position, bmed-medicine ball throw, 10mvs-10 m standing start, 20mvs-20 m standing start, 20mls-20 m flying start, ponat-backward polygon, oss-figure eight with bending, N-number of respondents, M-arithmetic mean, S.D-standard deviation, t-value of independent T test, Sig.-significance, Es.-effect size of difference.

Looking at the data listed in the graph, it can be seen that there are no major differences in the results of most tests between respondents according to gender. It can be seen that in two of the three tests for assessing explosive power, there is a statistically significant difference in the medicine ball throw test, in which boys achieved better results, while in the standing long jump and standing triple jump tests there is no statistically significant difference, which leads to the conclusion that there is a possibility that the strength of the shoulder girdle is greater in boys than in girls. A statistically significant difference was also shown in the test running 20 m from a flying start, where boys achieved better results than girls, while there was no statistically significant difference in the tests running 10 m from a standing start and running 20 m from a standing start, which points to the conclusion that boys had the ability to accelerate better. The best age period for the development of speed and agility is still disputed, so it is considered that the dynamics of speed development in boys and girls is almost identical until the age of 14, after which girls' development stagnates, while boys' development will continue until the age of 18 by selecting training operators that can ensure the realization of the potential of acquired and innate speed (Milanovic, Jukic, Nakic & Custonja, 2003). Holm (1987) distinguishes three best age periods for training

speed and agility: 12-14 years for acceleration skills, 13 - for speed with a change of running direction and 15 for speed endurance. The more intensive phase for improving speed in boys and girls is between the ages of 7 and 9, and after the age of 14 boys can continue to improve their speed until adulthood, which is not the case for girls (Jukic, 2003). Since it is assumed that boys achieved a better result in running 20 m from a flying start with a better ability to learn, it can be said that the results of this research are in accordance with Holm's assumption that the critical period for the development of acceleration skills is in the age period of 12-14 years.

There was no statistically significant difference in the tests for assessing the level of coordination or in the test for assessing general endurance. The level of aerobic capacity of schoolchildren is decreasing year by year (Azevedo et al., 2021; Toshboyeva, 2022), which is worrying because a good level of development of general endurance is the foundation for the development of other abilities, such as specific endurance, strength, speed, flexibility and coordination (Faigenbaum et al., 1999; Mikkonen et al., 2023). It is also considered that the best period for developing aerobic capacity is the age of 8-15 years for boys, and 9-12 years for girls (Guzhalovski, 1986), or the ages of 8-10 years and 12-15 years for boys, and 10-13 years and 15-17 years for girls (Guba et al., 2021). In this research, it was shown that the level of general endurance was the same in both boys and girls, which can be optimal for improving other motor skills, and as all respondents were 12 ± 6 months old, they were at an age when it was possible to work on improving aerobic capacity according to the mentioned authors.

Therefore, after analyzing the average values, it can be noted that male respondents achieved better results in all tests, however, a statistically significant difference was found only in two tests in favor of male respondents. A statistically significant difference was observed in one test that assessed explosive power (medicine ballll throw *t-2.19, sig.-0.03*) and one test that assessed speed (20 m standing start *t-2.17, sig.-0.03*).

It is assumed that studies on a large sample of young basketball players (aged 7 to 17) reveal the best age for the development of speed and agility skills, so the results obtained in this study should be considered with caution because a relatively small sample was analyzed. It should also be borne in mind that the biological maturity of children and adolescents at the same age may be different, and for this reason it could be recommended to train speed and agility during the sensitive age period from 7 to 17 years, and to pay more attention to the development of speed in the critical periods of 8-10 and 13-17 years. In addition, it is recommended to develop speed and agility with specific movements and actions for basketball with and without the ball. Since, according to the LTAD model, the period from the age of 10 to 14 is the period of formation, it is suggested that a multifaceted way of working ensures quality formation and development of basic fitness characteristics and technical-tactical knowledge, so experts recommend the purposeful development of one or another ability in a certain period of time (Goldfield et al., 2012; Kabanov et al., 2019). It is important to emphasize that the difference between sensitive and critical periods is that training outside the critical period may have no effect on the trained ability, while training outside the sensitive period has a reduced effect (Knudsen, 2024).

CONCLUSION

Children are in a sensitive period of life, and gender differences in early childhood are minimal. During childhood, girls tend to mature faster than boys so that at any given age, girls as a group are biologically more mature than boys. In terms of growth and development, significant differences between the sexes are emphasized during adolescence. In this research, it was shown that boys and girls involved in the basketball training process (of the same chronological age) achieved equal results in tests for assessing explosive leg strength, agility and general endurance. The difference was shown in the level of explosive strength of arms and in the speed with acceleration. The obtained results indicate that there are certain differences in the expression of motor skills between boys and girls of the same chronological age, which confirmed the need to monitor sensitive periods. These results indicate the need to plan a training process for the development of motor skills in accordance with a multifaceted way of working with the aim of developing basic fitness characteristics and technical-tactical knowledge with the purposeful development of one or another skill in a certain period of time.

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DUGOROČNI RAZVOJ U TRENAŽNOM PROCESU MLADIH

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Sažetak: *Djeca i adolescenti doživljavaju brojne fizičke promjene kao rezultat rasta i sazrijevanja. Osjetljivo razdoblje u djetinjstvo je prilika za poticanje djetetovog razvoja, postavljanje prava temelje i maksimalno iskoristiti njihov potencijal za rast i razvoj. Jedan od modela razvoja sportista LTAD sugeriše da se tokom senzitivnih perioda trening usmjeri na višestrani rad i poboljšanje motoričkih sposobnosti kod djece i adolescenata. Košarka je timski sport koji zahtijeva visok nivo svih motoričkih sposobnosti, a brzina i agilnost su se pokazale među najpotrebnijim za uspjeh u košarci. Cilj istraživanja bio je utvrditi relacije između motoričkih sposobnosti i senzitivnih perioda u mlađem uzrastu djece uključene u trenažni process u košarci radi usmjeravanja trenažnog procesa. Uzorak ispitanika bili su djeca uzrasta 12 godina (+/- 6 mjeseci), 21 dječak i 20 djevojčica uključeni šest mjeseci u trenažni proces u košarci. Nivo motoričkih sposobnosti - opšta izdržljivost, eksplozivna snaga, brzina i agilnost procijenjen je pomoću sljedećih varijabli: potrošnja kiseonika, skok u dalj iz mjesta, troskok iz mjesta, bacanje medicinke, 10 m visoki start, 20 m visoki start, 20 m leteći start, poligon natraške, osmica sa saginjanjem. Statistički značajna razlika je primijećena kod jednog testa koji je procjenjivao eksplozivnu snagu (bacanje medicinke t-2,19, sig.-0,03) i jednog testa koji je procjenjivao brzinu (20 m visoki start t—2,17, sig.-0,03).*

Ključne riječi: *trenažni proces, senzitivni periodi, morfoloske karakteristike*