

DIFFERENCES IN MOTOR SKILLS DEVELOPMENT TRENDS IN YOUNG SKIERS**Toplica Stojanović¹, Zvezdan Savić², Žarko Bilić³, Darko Stojanović², Ljubiša Lilić¹**¹*Faculty of Sport and Physical Education, University of Priština seated in Kosovska Mitrovica, Serbia,*²*Faculty of Sport and Physical Education, University of Niš, Serbia,*³*Faculty of science and education, University of Mostar*

Original scientific paper

Abstract

Aim of this study was to determine differences in the trend of motor skills development of young skiers. The sample of participant (85) consisted of two subsamples, male and female skiers, where each subsample is divided into three age categories (AC I: 13-14 ; AC II: 11-12 and AC III: 9-10). To evaluate these motor skills, a Eurofit battery of tests was used. Results indicate that the trend of development of the motor skills differs. The development of speed and explosive strength among male skiers is not equal, progresses slowly up to the age of 12, only to increase rapidly at the age of 13. In the case of female skiers this trend in the area of speed is more stable and rapid, and in the case of explosive strength is slower and insignificant. In the space of agility, the trend of development both among male and female skiers is rapid until the age of 12, only to slow down after that time. In the case of flexibility, no statistically significant changes were determined in the studied age group ranging from the ages of 9 to 14. Based on research results can be concluded that during the planning of training of motor skills, we must take great care to harmonize the training content and sensitivity phases, and especially the critical phases during which these abilities develop optimally.

Key words: *development, motor skills, male skiers, female skiers, younger age categories*

Introduction

Motor skills are abilities which are significant for the optimum growth and development of children (Malina et al., 2004a). They begin to develop at birth, with certain changes that take place over the years, and this development is not always equal for boys and girls (Virus et al., 1999). For each motor skill there is a certain period of time (a sensitivity phase) during which the greatest changes occur (Asendorpf & Teubel, 2009). The change in the level of motor skills is an important part of growth and development, and it depends on chronological and biological age, gender, and is influenced by a series of endogenic and exogenic factors (Malina, 2011).

Physical activity is cited as being one of the exogenic factors which influence growth and development (Welk, 1999). The shared characteristic of the influence of physical activity on motor skills lies in the fact that the possible influence on such skills with a greater level of innateness is smaller and vice versa (Stodden, Langendorfer & Robertson, 2009). In order to influence these highly innate skills, it is necessary to commence with physical activity as soon as possible, respecting the sensitive periods for the development of certain features and skills (Ahnert & Schneider, 2007; Malina et al., 2015). In Alpine

skiing, those motor skills which have a significant effect on the final outcome are the most important ones. Among them agility, explosive and repetitive strength and balance stand out as the motor skills which make the greatest contribution to the success of competitors in Alpine skiing. However, in younger age categories, it is necessary to begin developing all motor skills, not only those which are closely bound to success in Alpine skiing as soon as possible. This is very important for the overall development of a young athlete. This development can be realized through various training content, applied in various types of sport. The development of the motor skills of young male and female skiers can be realized over a training process which is carried out in a planned fashion, rationally, in an organized manner. Thus, its planning and programming is necessary, along with its realization and finally control (Bandalo & Lešnik, 2011; Pate, 2006). It is of no less importance when training involving certain motor skills begins, taking into consideration the sensitive phases during which these skills can develop optimally (Malina, 2007).

For these reasons it is necessary to determine during which periods certain motor skills of skiers develop faster, and up to which age group it is possible to develop them optimally. This is the aim of the current study, to use the differences in the

trend of development of the motors skills of young male and female skiers to answer the research questions.

Methods

The sample of participant included 85 young skiers (boys and girls) with a chronological age of 9 to 14, classified into 2 subsamples, male skiers (48) and female skiers (37), where each subsample is divided into three age categories (AC) [AC-I: 13-14 y. (N=29); AC-II: 11-12 y. (N=27) and AC-III: 9-10 y. (N=29)]. All of the participants were healthy and suffered from no impairments. The study was carried out according to the ethical standards of Declaration of Helsinki and approved by the local institutional review board. All subjects voluntarily participated in testing after being informed of the purpose of the study and after obtaining parental written consent.

In order to evaluate the motor skills, we used a Eurofit battery of tests (Adam et al., 1988). The battery consisted of 10 tests, adapted for children. The following motor skills were tested: FLEXIBILITY – the seated forward bend (cm) (FLEX), SPEED – the 10m sprint (s) (SPR10S), the 10m sprint with a flying start (s) (SPR10FS), the 20 m sprint (s) (SPR20S), AGILITY – the T test (s) (AGIL), running sideways 20m (s) (RSW20), running backwards

10m (s) (RBW10), EXPLOSIVE STRENGTH – the vertical jump from a semi-squat, hands on hips (cm) (VSJHH), the vertical jump from a semi-squat, arm swing (cm) (VSJAS) and ENDURANCE – the Shuttle run test (m) (SHUT).

Statistical analysis included descriptive analyses (means and standard deviations for the each age categories in subsamples as a whole). Significance of main and interaction effects were analyzed using a two-way analysis of variance (ANOVA) (3 x 2). Factors included age categories (AC-I, AC-II and AC-III) and sex (M and F). Tukey HSD post hoc test were used to test the differences between group pairs. A criterion α level of $P < 0.05$ was used to determine statistical significance. The data were processed using the STATISTICA 7.0 for Windows (StatSoft, Inc., Tulsa, OK).

Results

At the initial measuring, it was necessary to determine the differences in the dependent motor skills variables between the age categories (AC-I: 13-14; AC-II: 11-12 and AC-III: 9-10) within the group of male and female skiers. For that purpose, a 2 way multivariate/univariate analysis of variance was used, and the results of this analysis are shown in tables 1 - 3.

Table 1. Test of Between-Subjects Effects in motor skills of **skiers**

	Wilks	F	Effect df	Error df	p
AGE	0.334	5.11	20	140	0.000*
SEX	0.589	4.88	10	70	0.000*
SEX*AGE	0.743	1.12	20	140	0.336

Legend: F – value of the Wilks test for analyzing the significance of difference between centroid of groups; Effect df, Error df – degrees of freedom; p – significance coefficient.

A two-way (3x2) ANOVA with age categories (AC-I, AC-II, AC-III) and sex (M, F) as between-subjects factors revealed a main effects of AGE, $F_{(20, 140)} = 5.11$, $p = .000$, and SEX, $F_{(10, 70)} = 4.88$, $p = .000$. These main effects were not qualified by an interaction between AGE and SEX, $F_{(20, 140)} = 1.12$, $p = .336$ (Table 1).

Posthoc analyses using Tukey's HSD indicated that the differences between the AGE categories within the group of male skiers (Table 2) contributed to the statistically significant difference in all of the measured abilities, except flexibility, where no statistically significant difference was determined.

Differences between the AGE categories within the group of female skiers (Table 3) contributed to the statistically significant difference in all of the measured abilities, except flexibility, vertical jump from a semi-squat with hands on hips and shuttle run test.

Table 2. Univariate differences in motor skills between AGE categories - **male skiers**

Variable	Mean \pm Std.Dev. M.skiers I (N=18)	Mean \pm Std.Dev. M.skiers II (N=15)	Mean \pm Std.Dev. M.skiers III (N=15)	Tukey Post Hoc
FLEX _(cm)	16.03 \pm 8.24	14.07 \pm 6.01	14.53 \pm 5.55	
SPR10S _(s)	2.00 \pm 0.16	2.16 \pm 0.15	2.28 \pm 0.15	*(I-II) (I-III)
SPR10FS _(s)	1.52 \pm 0.13	1.68 \pm 0.14	1.80 \pm 0.14	*(I-II) (I-III)
SPR20S _(s)	3.53 \pm 0.28	3.86 \pm 0.29	4.09 \pm 0.28	*(I-II) (I-III)
AGIL _(s)	12.34 \pm 1.24	13.62 \pm 1.46	15.32 \pm 1.59	*(I-III) (II-III)
RSW20 _(s)	7.10 \pm 0.77	7.77 \pm 0.93	8.87 \pm 0.93	*(I-III) (II-III)
RBW10 _(s)	2.97 \pm 0.33	3.32 \pm 0.41	3.79 \pm 0.60	*(I-III)
VSJHH _(cm)	30.09 \pm 4.97	26.27 \pm 4.74	22.74 \pm 3.92	*(I-II) (I-III)
VSJAS _(cm)	36.26 \pm 6.12	28.37 \pm 6.34	26.67 \pm 5.31	*(I-II) (I-III)
SHUT _(m)	1282.67 \pm 364.01	1012.00 \pm 342.83	927.78 \pm 383.74	*(I-III)

Legend: Mean – arithmetic means; Std.Dev – standard deviation; F.skiers – female skiers; N – the number of participants; *(I-II) (I-III) (II-III) statistical significance of differences between the pairs of groups (Tukey HSD post hoc test).

Table 3. Univariate differences in motor skills between AGE categories - **female skiers**

Variable	Mean \pm Std.Dev. F.skiers I (N=11)	Mean \pm Std.Dev. F.skiers II (N=12)	Mean \pm Std.Dev. M.skiers III (N=14)	Tukey Post Hoc
FLEX _(cm)	21.77 \pm 5.42	19.29 \pm 3.99	19.96 \pm 3.44	
SPR10S _(s)	2.07 \pm 0.10	2.19 \pm 0.16	2.39 \pm 0.15	*(I-III) (II-III)
SPR10FS _(s)	1.56 \pm 0.09	1.72 \pm 0.13	1.89 \pm 0.15	*(I-II) (I-III) (II-III)
SPR20S _(s)	3.62 \pm 0.20	3.92 \pm 0.29	4.26 \pm 0.27	*(I-III) (II-III)
AGIL _(s)	13.37 \pm 1.32	14.04 \pm 1.31	16.54 \pm 1.82	*(I-III) (II-III)
RSW20 _(s)	7.77 \pm 0.84	8.06 \pm 0.73	9.58 \pm 1.03	*(I-III) (II-III)
RBW10 _(s)	3.11 \pm 0.48	3.46 \pm 0.50	4.27 \pm 0.70	*(I-III) (II-III)
VSJHH _(cm)	25.62 \pm 4.89	24.05 \pm 3.04	21.72 \pm 3.78	
VSJAS _(cm)	32.65 \pm 6.75	28.40 \pm 4.02	24.31 \pm 2.28	*(I-III)
SHUT _(m)	927.27 \pm 278.75	833.33 \pm 181.98	674.29 \pm 269.98	

Legend: Mean – arithmetic means; Std.Dev – standard deviation; F.skiers – female skiers; N – the number of participants; *(I-II) (I-III) (II-III) statistical significance of differences between the pairs of groups (Tukey HSD post hoc test).

Discussion

Based on the obtained results it is clear that there are statistically significant differences between the age categories of male and female skiers in all motor skills, except in the space of flexibility, where no significant level was determined, either for the male or the female skiers, and in the space of endurance for the female skiers.

Analyzing the results of male skiers in the space of speed and explosive strength, where a significant difference was noted between the oldest skiers and the remaining two categories, we can note that the trend of development of these motor skills was slower in the period between the ages of 9 and 12, and that after that time it progressed more rapidly. This can be explained by the fact that the ability to increase in speed and achieve maximum speed among boys aged 12 increases at the expense of movement speed, which primarily depends on the flexibility of the nervous system. At the ages between 12 and 14 it increases at the expense of the growth of the body, explosive strength and increase in muscle strength, and it lasts until the ages of 18 and 19 (Papaiakovou et al., 2009; Mayers et al., 2010). The sensitive period of development of explosive strength is from the ages of 8 to 17, and the critical phases in its development are from the ages of 8-9, 10-11, 13-14, and especially between the ages of 14-15 (Figueiredo et al., 2009). Our results are in agreement with previous research, which has confirmed that the critical phases of development of increase in speed and achieving maximum speed in the case of boys is between the ages of 7-9 and 11-15 (Malina et al., 2004b). In the case of the agility of young skiers, we can note the curve of development of this ability begins earlier with an increased rate of growth, at the age of 9-10 but slows down at the age of 12. Thus, its increase up until the age of 14 is evident, but not statistically significant. These results confirm the opinions of some authors that agility develops very dynamically in the period between the ages of 7 and 11/12 (Malina et al., 2004b), with the addition that in the pre-pubescent period the mobility of the nervous processes is great, and so the formation of conditional reflex connections is easy, as is the ability to use quick changes in excitation and stopping to influence the central nervous system. After this optimum period, the CNS changes very little, and thus the ability to influence the development of agility (Okely et al., 2001b; Fisher et al., 2005). The results of the endurance test indicate that the development of this ability is uneven in the period from the ages of 9-14, similar to the trend of development of speed and explosive strength, but no statistically significant difference was noted between the neighboring age categories, but only between the youngest and oldest

skiers. A difference was noted in endurance between the youngest and mid age level skiers in relation to the differences between the mid age level and oldest skiers, but only at the informative level. Still, from this fact it is possible to conclude that the development of endurance increased after the age of 13, which is in accordance with the results of previous studies (Vaeyens, 2006; Okely et al., 2001a).

In the case of female skiers, the trend of development of motor skills is somewhat different than the one among the male skiers. Unlike the trend of development of speed and explosive strength of the skiers, we can note that between the ages of 9 - 14 among the female skiers it is steady and constant. A steady and statistically significant trend was noted in the development of speed in the studied period, while in the case of explosive strength it was equal, but led to no statistically significant difference between the neighboring age groups, and instead one was noted only on the informative level. This can be explained by the fact that girls mature much earlier than boys, that is, that their body development, the increase in explosive strength and muscle strength (from the ages of 10 -12) occurs much earlier among girls, and as a consequence the development of speed also begins earlier, but ends sooner as well. These results are in accordance with the previous results achieved by several authors (Hands, 2008; Papaikovou et al., 2009; Mayers et al., 2010). The trend of development of the agility of female skiers has the same tendency as among male skiers, but with a somewhat higher means, which is normal considering the gender differences which significantly affect the manifestation of this motor skill. In the space of endurance of female skiers, we can note a different trend in the development of this skill than among the male skiers, considering that the difference between the young and mid age level groups of female skiers is greater compared to the difference between the mid age level and oldest female skiers. These differences are not statistically significant. However, based on the determined quantitative differences we can still conclude that the trend of development of endurance of female skiers is more rapid between the ages of 9 and 12 (Hands, 2008), and that it is somewhat slower between the ages of 13 and 15. Along with the aforementioned fact that girls mature earlier than boys, it is understandable that the development of endurance among girls begins sooner, but that it also peaks sooner.

In the study of the limits of the sensitivity phase and the critical phases of development of certain motor skills of young male skiers, we must take into consideration their chronological and biological age (Lloyd et al., 2014). Chronological age and the development of children in most cases match (Malina, 2011). However, there are cases when for the precise determination of the age, it is more useful to use the evaluation of biological age

(Beunen & Malina, 1988). By comparing the indicators of calendar and biological age, among children of the same age we can make a distinction between pronounced accelerants and retardants. In the more current conditions, we should also take into consideration the significance of the occurrence of acceleration (Malina, 2007). It is not only manifested as a characteristic occurrence of growth, but includes other psychological, spiritual and physiological occurrences. It is possible to note harmonious, disharmonious accelerations, as well as the occurrence of retardants (Stojanović et al., 2009).

Conclusion

Based on the results of the comparison of the motor skills of male and female skiers aged 9 to 14, where the differences between the age categories of 9-10, 11-12 and 13-14 were analyzed, especially within the group of male and female skiers, we can conclude that the trend of development is different between male and female skiers.

In the case of male skiers an uneven trend of development of speed, explosive strength and endurance was noted, and a somewhat slower development for the younger categories, only for it to rapidly increase after the age of 12. The development of agility in the younger categories is more rapid, only for it to slow down after the age of 12. In the case of flexibility, no significant improvement was noted during the studied age groups, either for the male or female skiers. Unlike the male skiers, for the female skiers the trend of the development of speed and explosive strength

was even during the period between the ages of 9 and 14, and displayed a tendency of even growth. The development of the agility of female skiers has the same tendency of development as among the male skiers, and in the case of endurance this trend of development is reverse for the male skiers, that is, it develops more quickly among the younger age categories of female skiers, only to slow down after the age of 12.

What presents itself as a conclusion is that during the planning of the training of motor skills, we must take great care to harmonize the training content and sensitivity phases, and especially the critical phases during which these abilities develop optimally. If we do not act in a timely fashion and develop certain skills, this cannot be remedied later. Neglecting the sensitivity periods and critical phases reaches almost the ultimate limits, so any early specialization is still a strategy of long-term sports development, irrespective of its breaking the basic principles of human biological development. A great amount of training content is applied in working with children, who at that level are not developed enough for such structures to be acquired. A great many athletes are not given the chance to achieve their maximum in the development of motor skills, only because the sensitivity periods and critical phases were neglected.

In other words, the biological assumptions on development must be primary in determining the strategy of applying training content, primarily from the standpoint of their successive and differentiated influence during certain sensitivity periods, especially during the critical phases of development.

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RAZLIKE TREND A RAZVOJA MOTORIČKIH SPOSOBNOSTI MLADIH SKIJAŠA

Sažetak

Cilj istraživanja je bio utvrđivanje razlike trenda razvoja motoričkih sposobnosti mladih skijaša. Uzorak ispitanika (85) je sačinjen od dva subuzorka, skijaša i skijašica, gdje je svaki subuzorak podijeljen na tri uzrasne kategorije (AC I: 13-14; AC II: 11-12 i AC III: 9-10). Za procjenu motoričkih sposobnosti korištena je baterija Eurofit testova. Rezultati ukazuju da je trend razvoja motoričkih sposobnosti različit. Trend razvoja brzine i eksplozivne snage kod skijaša je neravnomjeran, usporen do 12 godine, da bi se od 13 ubrzao, dok je taj trend kod skijašica u prostoru brzine ravnomjeran i ubrzan, a kod eksplozivne snage usporen i neznatan. U prostoru agilnosti je trend razvoja i kod skijaša i skijašica ubrzan do 12 godine, da bi se nakon tog razdoblja usporio. Kod gipkosti nije bilo značajnih promjena u istraživanom uzrasnom razdoblju od 9-14 godine. Na osnovu rezultata istraživanja može se zaključiti da se u planiranju treninga motoričkih sposobnosti mora izuzetno voditi računa o usaglašavanju trenažnih sadržaja i senzitivnih perioda, a posebno kritičnih faza u kojima se te sposobnosti optimalno razvijaju.

Ključne riječi: razvoj, motoričke sposobnosti, skijaši, skijašice, mlađe kategorije.

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Received: 06 October 2017

Accepted: 20 December 2017

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