

Original research article

DIFFERENCES IN THE SPACE OF MOTOR SKILLS BETWEEN YOUNGER MALE AND FEMALE SKIERS

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Abstract. *Top competitive results in alpine skiing today, to a great extent, depend on proper planning and programming, the choice of suitable training content, forms of work, the application of suitable load and the harmony between periodization and the competitive season schedule. The aim of this research is to determine the differences in the motor space between male and female skiers, younger members of the ski clubs of the Skiing Association of Serbia, aged 9 to 15. In order to evaluate their motor skills, a battery of tests was used, recommended by the Committee for Sport and the Young of the Republic of Serbia. The applied motor tests were adapted to suit the children of the studied age group and are a part of the Eurofit battery of tests (Adam, Klissouras, Ravazzolo, Renon, & Tuxworth, 1988). The results of the analysis of variance indicate that a statistically significant difference in motor skills at the multivariate level exists between male and female skiers aged 9-10 in the space of flexibility, speed, agility and endurance, while in the remaining age categories no difference was noted.*

Key words: *motor skills, differences, male skiers, female skiers, younger categories of skiers.*

INTRODUCTION

Skiing is one of the specific sports which are based on learning and improving various motor skills and activities, and as such is closely related to snow-covered surfaces at higher elevations. Many authors point out that skiing is unique due to several special characteristics. Skiers are involved in their activities in a relatively cold environment, of-

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ten at high altitudes. Alpine skiers achieve great movement speed on various terrains, which requires quick and strong adaptation skills. In addition, skis often function as ploughs, which in the best sense can represent an extension of the muscle-skeletal system of the body, and in the worst case, a mechanism which can cause numerous sports injuries. Alpine skiing in Serbia has good potential for development. During previous seasons, Serbian skiers achieved average results at international competitions. A large number of objective and subjective factors have contributed to this fact. Permanent testing of the motor space of male and female skiers plays an important role in the evaluation of the training program. On the basis of these results, we can act in a timely fashion in order to achieve the expected outcome. Children skiers should especially be studied as unique individuals in a certain stage of development. Their normal and proper growth determines their overall capacity for performing physical activities.

Alpine skiing emphasizes those motor skills which have proven to have a positive effect on the results. They primarily include agility, explosive strength and balance as well as motor skills, which make the greatest contribution to the success of competitors in Alpine skiing. However, in the younger age groups, it is necessary to develop all the motor skills, and not only those which are closely related to success in Alpine skiing. The aforementioned is important for the overall development of a young athlete, which can only be realized by means of various sports, and various exercises and tasks (Cigrovski, Matković, & Vučetić, 2010).

A change in the level of motor skills cannot be separated from growth and development, and depends on chronological and physiological age, as well as gender. It is under the influence of an entire group of endogenic and exogenic factors (Prskalo, Kraljević, & Kovačić, 2011). Even at a younger age there is a significant difference between the genders, while their growth and development, as well as any changes in their motor skills should be taken into consideration when dosing load in all organized forms of work done with members of these age categories (Prskalo, Samac, & Kvesić, 2009; Prskalo et al., 2011).

Each sports training which is carried out unsystematically, without any appropriate professional control, without knowledge of the health of the athlete, adequate dosing of the training load and monitoring of any changes, inevitably leads to poor results and unwanted consequences. Precisely this fact necessitates a very responsible approach of the experts to the planning, programming, realization and control of the training process (Živanović, Savić, Milojević, & Milutinović, 2003).

Scientific and practical solutions to the problem are only possible if we use a whole-some analysis in which the planning and programming of the training process of skiers is viewed as a process of adjustment, adaptation during the process of development and improvement of physical characteristics with a strict adherence to the biodynamic and kinematic structures of a certain sport (Željaskov, 2003).

In the case of alpine skiers, explosive and repetitive strength of the lower extremities hold a prominent position in the physical preparation process. A number of studies have shown that alpine skiers have very strong lower extremities in relation to other athletes, and that leg strength is an important factor among male and female skiers (Song, 1982; Tesch, 1995).

The aim of this research is to analyze the differences in the results of the motor space in male and female skiers, all members of several ski clubs of the Skiing Association of Serbia, on the basis of which it is possible to plan the proper operationalization in prac-

tice, especially due to the fact that the training of male and female skiers is simultaneously realized on the same slope, which decreases the possibility of group homogenization and optimization of the training load.

METHODS

The sample of participants

The sample of participant included 85 young skiers (boys and girls) with a chronological age of 9 to 15, classified into 2 sub-samples, i.e., male skiers (N=48) and female skiers (N=37), where each sub-sample was divided into three age categories (9-10; 12-13 and 14-15 years, respectively). All of the participants were healthy and suffered from no impairments. The testing was carried out in November 2010 in the following cities: Knjaževac, Beograd and Nova Varoš.

The sample of measuring instruments

In order to evaluate the motor skills of male and female skiers, a battery of tests recommended by the Committee for Sport and Youth of the Republic of Serbia was used. The battery consisted of 10 tests. The applied motor tests were adapted for children of the studied age and were part of the Eurofit battery of tests (Adam, Klissouras, Ravazzolo, Renson, & Tuxworth, 1988). The following motor skills were tested: FLEXIBILITY – the seated forward bend (PRETK); SPEED – the 10 m sprint (SPR10S); the 10 m sprint with a flying start (SPR10LS); the 20 m sprint (SPR20S); AGILITY – the T test (AGIL); running sideways (TBOČ20), running backwards (TNAZ10); EXPLOSIVE STRENGTH – the vertical jump from a semi-squat, hands on hips (VSBR); the vertical jump from a semi-squat, arm swing (VSZR); ENDURANCE – the Shuttle run (ŠATL).

Statistical analyses

Due to the nature of the research and the need to plan training sessions, it was necessary to gather data on both the male and female skiers during a measuring session prior to the preliminary period. In order to determine the differences between the groups, a Multivariate and Univariate Analysis of Variance were used (MANOVA/ ANOVA). At the multivariate level, the following parameters were calculated: Wilks' Lambda – the value of the coefficient of Wilks' test of group centroid equality; F – the value of the coefficient of the F-test for the significance of Wilks' Lambda; Effect df and Error df – the degrees of freedom; p – the coefficient of the significance of the centroid differences; while the values of the F-test and the coefficient of the significance of the difference between the means (p) were calculated at the univariate level for each variable. The data were processed using the STATISTICA 8.0 program for Windows.

RESULTS

At the initial measuring, it was necessary to determine the differences in the dependent motor variables between the male and female skiers of various age groups (9-10; 11-12 and 14-15 years). For that purpose a Multivariate/Univariate Analysis of Variance was used, and the results of that analysis are shown in tables 1-6.

Table 1. The multivariate differences in the motor skills between male and female skiers aged 9-10.

Wilk's Lambda	F	Effect df	Error df	p
0.354	3.83	10	21	0.005*

Wilks' Lambda – value of the coefficient of the Wilks' test for the equality of group centroids; F – the value of the F-test coefficient for the significance of Wilk's Lambda; Effect df and Error df – degree of freedom; p – the coefficient of the significance of the difference between the centroids

Table 2. The univariate differences between the motor skills of male and female skiers aged 9-10.

Variable	Mean		F (1,30)	p
	Males (N=18)	Females (N=14)		
PRETKL	14.53 \pm 1.12	19.96 \pm 1.27	10.32	0.003*
SPR10S	2.282 \pm 0.04	2.392 \pm 0.04	4.23	0.049*
SPR10LS	1.800 \pm 0.03	1.886 \pm 0.04	2.75	0.108
SPR20S	4.093 \pm 0.06	4.262 \pm 0.07	2.97	0.095
AGIL	15.32 \pm 0.40	16.54 \pm 0.45	4.09	0.052
TBOČ20	8.865 \pm 0.23	9.581 \pm 0.26	4.25	0.048*
TNAZ10	3.789 \pm 0.15	4.273 \pm 0.17	4.47	0.043*
VSBR	22.74 \pm 0.91	21.72 \pm 1.03	0.55	0.465
VSZR	26.67 \pm 1.01	24.31 \pm 1.14	2.42	0.130
ŠATL	928 \pm 79.9	674 \pm 90.6	4.40	0.044*

Mean – arithmetic mean; N – number of participants; F – value of F-test for testing the significance in differences of the arithmetic means; p – coefficient of significance in differences of the arithmetic means

Table 3. The multivariate differences in the motor skills between male and female skiers aged 11-12.

Wilk's Lambda	F	Effect df	Error df	p
0.493	1.65	10	16	0.181

Wilks' Lambda – value of the coefficient of the Wilks' test for the equality of group centroids; F – the value of the F-test coefficient for the significance of Wilk's Lambda; Effect df and Error df – degree of freedom; p – the coefficient of the significance of the difference between the centroids

Table 4. The univariate differences between the motor skills of male and female skiers aged 11-12.

Variable	Mean		F (1,25)	p
	Males (N=15)	Females (N=12)		
PRETKL	14.07 \pm 1.35	19.29 \pm 1.51	6.69	0.016*
SPR10S	2.162 \pm 0.04	2.190 \pm 0.04	0.21	0.653
SPR10LS	1.682 \pm 0.03	1.724 \pm 0.04	0.65	0.429
SPR20S	3.859 \pm 0.07	3.925 \pm 0.08	0.34	0.563
AGIL	13.62 \pm 0.36	14.04 \pm 0.40	0.59	0.450
TBOČ20	7.772 \pm 0.22	8.062 \pm 0.24	0.78	0.385
TNAZ10	3.317 \pm 0.12	3.460 \pm 0.13	0.67	0.419
VSB	26.27 \pm 1.05	24.05 \pm 1.18	1.97	0.173
VSR	28.37 \pm 1.41	28.40 \pm 1.57	0.00	0.990
ŠATL	1012 \pm 73.2	833 \pm 81.8	2.65	0.116

Mean – arithmetic mean; N – number of participants; F – value of F-test for testing the significance in differences of the arithmetic means; p – coefficient of significance in differences of the arithmetic means

Table 5. The multivariate differences in the motor skills between male and female skiers aged 14-15.

Wilk's Lambda	F	Effect df	Error df	p
0.475	1.66	10	15	0.182

Wilks' Lambda – value of the coefficient of the Wilks' test for the equality of group centroids; F – the value of the F-test coefficient for the significance of Wilk's Lambda; Effect df and Error df – degree of freedom; p – the coefficient of the significance of the difference between the centroids

Table 6. The univariate differences between the motor skills of male and female skiers aged 14-15.

Variable	Mean		F (1,24)	p
	Males (N=15)	Females (N=11)		
PRETKL	16.03 \pm 1.86	21.77 \pm 2.17	4.03	0.056
SPR10S	2.002 \pm 0.04	2.075 \pm 0.04	1.80	0.192
SPR10LS	1.520 \pm 0.03	1.560 \pm 0.03	0.82	0.375
SPR20S	3.527 \pm 0.06	3.622 \pm 0.08	0.93	0.344
AGIL	12.34 \pm 0.33	13.37 \pm 0.39	4.05	0.056
TBOČ20	7.103 \pm 0.21	7.771 \pm 0.24	4.41	0.046*
TNAZ10	2.970 \pm 0.10	3.109 \pm 0.12	0.77	0.388
VSB	30.85 \pm 1.27	25.62 \pm 1.49	7.15	0.013*
VSR	36.26 \pm 1.65	32.65 \pm 1.93	2.02	0.168
ŠATL	1283 \pm 85.5	927 \pm 99.9	7.31	0.012*

Mean – arithmetic mean; N – number of participants; F – value of F-test for testing the significance in differences of the arithmetic means; p – coefficient of significance in differences of the arithmetic means

By analyzing the results obtained at the multivariate level, we can conclude that between the male and female skiers aged 9-10, there is a statistically significant difference

in the studied motor space, and the values of Wilks' Lambda (0.354) and Rao's approximation ($F=3.83$), along with a degree of freedom of 10 and 21. Results indicate a statistically significant difference at the $p=0.005$ level (Table 1). Among the male and female skiers aged 11-12 and 14-15, at the multivariate level, no statistically significant difference was determined (Tables 3 and 5).

At the univariate level, we determined that the difference between the male and female skiers aged 9-10 (Table 2) was statistically significant, in favor of the male skiers for the speed of running (the 10 m sprint with a flying start), agility (running sideways at a distance of 20 m, running backwards at a distance of 10 m) and endurance (the shuttle run). However, a difference in flexibility (the seated forward bend) was in favor of the female skiers.

In the 11-12 age group, statistically significant difference was determined between the male and female skiers, but only for flexibility, where the female skiers showed better results, while for the remaining motor skills no statistically significant differences were determined (Table 4). In the 14-15 age category, these differences are noted for agility, explosive strength and endurance, where the male skiers were more dominant, while the female skiers were better at flexibility. However, the difference is on the borderline of statistical significance ($p=0.056$, Table 6).

DISCUSSION

On the basis of the obtained results it is clear that the male and female skiers differ in terms of motor skills only within the 9-10 age category, while in the 11-12 and 14-15 age categories these differences at the multivariate level decrease and cannot be classified as statistically significant.

By analyzing the results of the skiers aged 9-10 in terms of motor skills, we can conclude that the male skiers were dominant in terms of speed, agility and endurance, and the female skiers in terms of flexibility. The trend of the domination of male skiers in the space of motor skills is especially pronounced in the younger categories of school-aged children, and can probably be explained by a higher level of motor skills among the boys of this age group, conditioned by the faster movement of impulses from the cortex to the effectors located in the muscles. Female skiers achieved more statistically significant and better results in the test for the evaluation of agility of the hamstrings of the upper legs and the lower back, and this trend is apparent in the entire analyzed period, which is in agreement with the results of previous studies (Milne, Seefeldt, & Reuschlein, 1976; Branta, Haubenstricker, & Seefeldt, 1984; Matić, 2007; Obradović, Cvetković, & Krmeta, 2008; Batez, Krsmanović, Dmitrić, & Pantović, 2011; Sabolč & Lepeš, 2012). This occurrence is linked to greater flexibility of the girls during the period of growth and development than the flexibility of boys of the same age (Gajić & Kalajdžić, 1986). What also contributes to this difference is the biological position of the pelvis in girls and the smaller angle of the connection between the femur in the joint surface of the pelvis.

Starting from the age of 11, all the way to 15, the differences between male and female skiers in terms of motor skills disappear (except in the case of flexibility in which female skiers retain a trend of achieving better results), which can be explained by the quicker acceleration of the female skiers in the period from age 11 to 13, that is, in the period of the adolescence growth spurt when they achieve their maximum, both in terms

of the morphological and motor space, which is in accordance with the results presented by author Mišigoj-Duraković (2008). For school age boys motor skills improve with age in adolescence, while girls reach the peak of their abilities at age 14, that is 15. However, this is not in agreement with most of the results of studies which dealt with the differences between school-aged boys and girls (Kurelić et al., 1975; Mraković, Finder, Metikoš, & Neljak, 1996; Orjan, Kristjan, & Bjorn, 2005; Strel, 2006; Stojanović, Nešić, & Karalić; Mak et al., 2010; Starc, Strel, & Kovač, 2010; Ortega et al., 2011), where it is clear that within the space of motor skills, especially in the case of speed, agility and coordination, the boys significantly outperform the girls in the period from age 11 to 15. This discrepancy can today be explained by the well-researched lower level of usual physical activities (Petrić, 2011), and especially the reduced participation in organized recreational or sports activities of young girls in the aforementioned period, unlike the female skiers who are always in the process of full training, and these characteristics of theirs do not decrease, and instead increase as they do in the case of the boys. However, in study of Stojanović et al. (2008) involving populations of athletes of the same age, the hypothesis that young male athletes have significantly better motor skills than girls of the same age has been confirmed. This leads us to the conclusion that skiers aged 11-15 generally do not achieve better results than their peers in other sports, and that female skiers have at the same level of abilities as their peers involved in other sports, which can be explained by the possible weaker selection of skiers of the same age. It is clear from our results that even female skiers aged 15 have significantly lower results than younger female skiers aged 12 to 14, which can have a twofold interpretation: either that they are less active during that age in ski training programs and competitions, or that the selection of this generation is significantly weaker than for the younger generation of female skiers. It is clear that these conclusions must not be taken at face value, considering the small number of entities in each of the age categories of male and female skiers (N=11-18) and the reduced variability of the results, which can, during statistical procedures, lead to errors in the decision making process, as well as the lack of any comparative analysis of these results with the model characteristics of elite male and female skiers.

Generally speaking, in the trends of skier selection in Serbia can be said to, due to difficult economic conditions in these parts (which as a consequence also has significantly decreased funds available to ski clubs), significant financial obligations in the organization of the training process and attending competitions is taken over by the parents, and thus the selection of skiers is probably conditioned by the economic status of a family. This unmistakably leads to the decrease in the quality of the selected skiers, and thus to the reduced quality of their motor skills, that is, to non-systematic selection in ski clubs.

It is well-known that the systematic selection of children for a certain sport should satisfy the criteria of a future model, in this case the models of male and female skiers. In such a selection process, the basic aim is to select talented children who will be future elite athletes. Thus, the basic criteria include: morphological, motor, functional and immunological development, biochemical and cytochemical parameters and so on (Stojanović, Dragosavljević, & Kostić, 2009).

The chronological age and development of children in most cases co-inside. However, there are cases when for the precise determination of age it is more useful to use biological age. By comparing the indicators of calendar and biological age, the selector can, during the process of selection of children of the same age, distinguish between pronounced accelerants and retardants. In modern conditions we should take into considera-

tion the significance of the occurrence of acceleration. It occurs not only as a characteristic of growth, but also includes other psychological, spiritual and physiological occurrences. In all areas occurrences of harmonious and disharmonious acceleration are possible, as is the occurrence of retardants (Stojanović et al., 2009).

Based on the aforementioned reasons, a need arises for Serbian alpine skiing and ski clubs, irrespective of their financial situation, to select future male and female skiers based on the well-established principles and methods of selection, so that the results, both of clubs and national teams, could be adequate.

CONCLUSION

On the basis of the obtained results of the comparison between the motor skills of male and female skiers aged 9-15, analyzed based on age categories, we can conclude that skiers aged 9-10 have significantly better abilities of speed, agility and endurance, while female skiers of the same age, as well as those aged 11-12 and 14-15, have significantly better flexibility. In the age categories of 11-12 and 14-15, among male and female skiers, no statistically significant multivariate difference was determined in the remaining motor skills. We can further conclude that these results are different from the results of other studies which dealt with similar problems. Thus we can assume that this asynchronicity is probably the result of the weak selection of male and female skiers, but also the small sample of participants included for analysis of the age categories.

The conclusion that due to significantly decreased economic status of Serbian clubs there has been deterioration in the principles and methods of systematic selection of children for taking part in skiing should not be taken at face value, considering that for such a claim the results of this research need to be compared to the model characteristics of elite male and female skiers. However, the control and selection of children for skiing, from a scientific approach, must be lowered to the level of individual clubs, and should not only be found in the selection process for national teams. This will create a larger database for the selection of elite representative skiers.

In addition, for achieving significantly better results of the male and female skiers from Serbian clubs and the national team, it is necessary for the professional-pedagogical work in the sports-training process to be based on certain models of more successful ski federations and adapted to the conditions of skiing in Serbia. We point out that the formula for success in competitive skiing includes a high level of basic motor preparation, psychological potential and competitive preparation of the skiers themselves.

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RAZLIKE U PROSTORU MOTORIČKIH SPOSOBNOSTI IZMEĐU SKIJAŠA I SKIJAŠICA MLADIH UZRASNIH KATEGORIJA

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Vrhunski takmičarski rezultati u alpskom skijanju danas u mnogome zavise od dobrog plana i programa, od izbora odgovarajućih trenažnih sadržaja, oblika rada, primene odgovarajućeg opterećenja kao i od usklađenosti sa periodizacijom i takmičarskim kalendarom. Cilj istraživanja je utvrđivanje razlika u motoričkom prostoru između skijaša i skijašica mlađih uzrasnih kategorija ski klubova članova Skijaškog saveza Srbije, starosti od 9 do 15 godina. Za procenu motoričkih sposobnosti korišćena je baterija testova koja je preporučena od strane Republičkog zavoda za sport i omladinu Republike Srbije. Primenjeni motorički testovi su primereni deci ispitivanog uzrasnog perioda i deo su Eurofit baterije testova (Adam, Klissouras, Ravazzolo, Renson, & Tuxworth, 1988). Rezultati analize varijanse ukazuju da statistički značajna razlika u motoričkim sposobnostima na multivarijantnom nivou postoji samo između skijaša i skijašica uzrasta 9-10 godina u prostoru fleksibilnosti, brzine, agilnosti i izdržljivosti, dok kod ostalih uzrasnih kategorija nije zabeležena razlika.

Ključne reči: *motoričke sposobnosti, razlike, skijaši, skijašice, mlađe kategorije.*