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Kratko saopštenje

Short Notice

Razvoj agilnosti i fleksibilnosti u skijanju

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Sažetak: Populaciju iz koje je uzet uzorak od 40 ispitanika, čine učenici osnovnih škola, muškog pola, uzrasta 13 i 14 godina ± 6 mjeseci, podjeljenih na grupu od 20 polaznika škole smučanja (eksperimentalna grupa) i grupu od 20 učenika obuhvaćenih samo redovnom nastavom fizičkog vaspitanja (kontrolna grupa). Cilj istraživanja je bio da se utvrde efekti posebno programiranog vježbanja na razvoj agilnosti i fleksibilnosti u okviru škole skijanja kod ispitanika eksperimentalne grupe**.** Za procjenu motoričkih sposobnosti primjenjeno je 10 testova koji definišu: 1. agilnost (koverta test, koraci u stranu, osmica sa savijanjem, poligon natraške i okretnost) i 2. fleksibilnost (pretklon desno, pretklon, zasuk dodir, pretklon raskoračno, duboki pretklon na klupici i čeona špaga). Rezultati multivarijantne analize kovarijanse su pokazali da se ispitanici eksperimentalne grupe statistički značajno razlikuju većim nivoom agilnosti i fleksibilnosti od ispitanika kontrolne grupe.

Ključne riječi: agilnost, fleksibilnost, eksperimentalna i kontrolna grupa, skijanje.

Development of Agility and Flexibility in Skiing

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Summary: Population from which a sample of 40 examinees has been taken is consisted of primary school pupils, of male sex, age 13 and 14 year ± 6 months, divided into a group of 20 attendants of school of skiing (experimental group) and a group of 20 pupils who only attend a regular schooling of physical education (control group). The aim of investigation was to determine effects of specially programmed training intended for improving agility and flexibility within the school of skiing at the examinees of experimental group. Ten tests were applied in estimate of motor abilities which define: 1. agility (envelope test, side steps, eight with bending, polygon backwards and dexterity) and 2. flexibility (bend to the right, bend, roll touch, bend astride, deep bend on bench and lateral split). Results of the multivariant analysis of covariance proved that experimental group of examinees are stastically significantly defferent in their higher level of agility and flexibility from the control group examinees.

Key words: agility, flexibility, experimental and control group, skiing.

Uvod

Skijanje spada u grupu anaerobno-aerobnih sportova. Učestale promjene pravca kretanja u skijanju, skokovi, otklizavanja, različita prizemljenja i neposredni kontakt sa snijegom, zahtjevaju od skijaša visok nivo motoričkih i funkcionalnih sposobnosti, potrebne psihomoralne osobine i raznovrsnost savladanih tehničko-taktičkih elemenata *(Krsmanović i Lukman 1993)*. Ove karakteristike skijanja pozitivno utiču na razvoj motoričkih dimenzija agilnosti, fleksibilnosti i koordinacije kod djece i odraslih, te se i definišu kao dominantne sposobnosti neophodne za uspješno bavljanjem skijanjem.

Introduction

SpSkiing falls into the group of anaerobic-aerobic sports. Frequent changes of direction of movement in skiing, jumps, skating, various landings and direct contacts with snow, require from the skier a high level of motor and functional abilities, necessary psycho-**morale** characteristics and diversity of learned technical-tactical elements (Krsmanović and Lukman 1993). These characteristics of skiing have a favorable influence on development of motor dimensions of agility, flexibility and coordination of children and grown- ups and are defined as dominant abilities necessary for successful skiing performance.

Agilnost predstavlja veoma kompleksnu motoričku sposobnost koju nije tako lako definisati. Ona se najčešće definiše kako sposobnost sportiste da brzo odreaguje na nadražaj, da izvede brz i efikasan start, da se kreće u željenom pravcu i da bude spreman da izvede brzu promenu pravca kretanja. Agilnost je motorička sposobnost koja je zasnovana na ranom početku usavršavanja. Višedimenzionalnost i relativno visoka genetska uslovljenost ove motoričke dimenzije određuje potrebu za treningom agilnosti skijaša u najranijim fazama sportskog usavršavanja. Najpovoljnije senzibilne faze za razvoj agilnosti su godine neposredno prije puberteta i one koje slijede nakon faze ubrzanog rasta i razvoja. Prema ovim saznanjima, zakonitosti razvoja agilnosti ne poklapaju se u potpunosti sa zakonitostima razvoja ostalih koordinacionih svojstava. Osnovna razlika je što se agilnost može u znatnoj mjeri unaprijeđivati u završnim fazama rasta i razvoja – u kadetskom i juniorskom dobu skijaša. Razlog tome vjerovatno je u zahtjevima motoričkih struktura kao manifestacija agilnosti. One su usmjerene prema kvalitetu mišićnog, ali i vezivnog tkiva, s obzirom da je jedan od osnovnih uslova za efikasno i brzo izvođenje promjena smjera kretanja u skijanju upravo kvalitet ligamentarno-tetivnog aparata *(Lanc 1998; Milanović 2007)*.

Fleksibilnost je sposobnost izvođenja pokreta sa velikom amplitudom. Najčešća mjera ove sposobnosti je maksimalna amplituda pokreta djelova tijela u pojedinim zglobnim sistemima. U skijanju je važno da se postigne veća fleksibilnost u svim djelovima lokomotornog sistema, dok u drugim sportovima zahtjevi za fleksibilnost nisu naročito izraženi. U osnovi ove sposobnosti sadržane su strukturalne osobenosti mišića i ligamenata i njihova elastičnost i, što je još važnije, struktura i oblik zglobnih tijela u kojima se pokret izvodi. Povećanjem fleksibilnosti značajno se smanjuje opasnost od povreda ligamenata i mišića, poboljšava se ukupna motorička efikasnost i na viši nivo se podiže stabilnost lokomotornog sistema.

Metod rada

Cilj istraživanja je bio utvrđivanje efekata programiranog vježbanja na razvoj agilnosti i fleksibilnosti u okviru škole skijanja kod ispitanika eksperimentalne grupe**.** Populaciju iz koje je izveden uzorak od 40 ispitanika, činili su učenici osnovnih škola, muškog pola, uzrasta 13 i 14 godina ± 6 mjeseci, podjeljenih na grupu od 20 polaznika škole skijanja (eksperimentalna grupa) i grupu od 20 učenika obuhvaćenih samo redovnom nastavom fizič-

Agility is a very complex motor ability which cannot be easily defined. It is most frequently defined as a sportsman's ability to react quickly to stimulation, to perform a quick and efficient start, to move into a desired direction and to be ready to perform a quick change of direction of movement. Agility is a motor ability which is based on the early start of specialization. Multidimensionality and a relatively high conditionality of this motor dimension determine necessity of training of the skiers' agility in the earliest phases of the sports specialization. The most favorable receptive phases for development of agility are the years immediately before puberty and those that follow after the phase of accelerated growth and development. According to these cognitions, laws of development of agility do not match completely with the laws of development of other characteristics of coordination. The main difference is that agility can be significantly advanced in the final phases of growth and development – in the cadet and junior age of skiers. The reason of this is probably in demands of motor structures as manifestation of agility. They are directed towards quality of both muscular and connective tissue regarding the fact that one of the main conditions of efficient and quick performance of directions of movement in skiing is just the quality of ligament-sinew apparatus (Lanc 1998; Milanović 2007).

Flexibility is ability of performance of movements with a large amplitude. The most frequent measure of this ability is the maximum amplitude of movements of the parts of the body in certain joint systems. What matters in skiing is to reach a larger flexibility in all parts of the locomotor system while in other sports demands of flexibility are not particularly expressed. Structural singularity of muscles and connective tissues and its elasticity are contained in the basis of this ability and, more important, structure and shape of joint organs where a movement is performed. By increasing flexibility a danger of connective tissue and muscles injury is significantly diminishing, overall motor efficiency is increasing and locomotor system stability is lifting on a higher level.

Method of Work

The aim of the research was to determine effects of the programmed training on development of agility and flexibility within the school of skiing of examinees of experimental group. Population out of which a sample of 49 examinees was derived was consisted of the pupils of primary schools, of male sex, 13 and 14 years of age ± 6 months, divided in a group of 20 attendants of the school of skiing (experimental group) and a group of 20 pupils who only attend a regular teaching of physical education

kog vaspitanja (kontrolna grupa). Za procjenu dimenzije agilnosti primjenjeni su slijedeći testovi: koverta test (MKOT), koraci u stranu (MKUS), osmica sa savijanjem (MOSS), poligon natraške (MPON) i okretnost (MOKNT). Procjenu dimenzije fleksibilnosti činili su testovi: pretklon desno (MPRD), pretklon, zasuk dodir (MPZD), pretklon raskoračno (MPRČ), duboki pretklon na klupici (MDPK) i čeona špaga (MČŠP).

Za izračunavanje efekata programiranog vježbanja korišćena je multivarijantna analiza kovarijanse.

Eksperimentalni tretman

Eksperiment je sproveden u drugom polugodištu školske 2010/11 godine sa učenicima osnovnih škola u regionu Banja Luke. Ispitanici eksperimentalne grupe, obuhvaćeni istraživanjem, pored redovne nastave fizičkog vaspitanja bili su uključeni u programirano vježbanje za razvoj agilnosti i fleksibilnosti u okviru škole skijanja sa tri časa nedjeljno, u trajanju sedam nedjelja u školskoj sekciji za fizičku kulturu. Primjena programa vježbi za razvoj agilnosti i fleksibilnosti (modifikovano prema Metikoš i sar. 2003, Nakić 2003, Krsmanović 2009) bila je individualizovana na osnovu sposobnosti i osobina ispitanika, radi povećanja efektivnog vremena vježbanja.

Vježbe agilnosti

- pokretljivost trupa stojeći kruženje kukovima u lijevu i desnu stranu, otklon trupom, kruženje kukovima u osmici;
- vježbe u paru – vučenje lopte, guranje lopte, poskoci i vučenje noge, naskoci;
- učenje trčanja iz raznih položaja – iz ležanja na trbuhu, iz ležanja na leđima – naprijed, iz ležanja na trbuhu – naprijed, okret za 90^{o};
- učenje trčanja sa promjenom smjera – trčanje oko motke u obliku slova T, trčanje oko motke iz sredine prema spolja, trčanje po poligonu, trčanje oko i iznad prepreke;
- učenje reaktivnog odraza u tri smjera – poskoci u poligonu sunožno, poskoci u poligonu lijevom nogom, poskoci u poligonu desnom nogom, poskoci u poligonu sunožno;
- razvoj agilnosti u sali – lagano trčanje u mjestu oslonjeni na ripstol, zanoženje i podizanje koljena, trčanje naprijed – skip rad ruku, trčanje nazad – skip pod ruku, trčanje bočno – skip rad ruku, abdukcija u mjestu;
- trčanje iz raznih položaja (start iz raznih položaja tri koraka naprijed): iz ležanja na leđima – naprijed, iz

(control group). The following tests were applied for the estimate of dimension of agility: envelope test (MKOT), aside steps (MKUS), eight with bending (MOSS), polygon backwards (MPON) and agility (MOKNT). The following tests were comprised by Estimate of flexibility dimension: bend to the right (MPRD), bend, roll-up touch (MPZD), straddle forward bend (MPRČ), deep forward bend on the bench (MDPK) and front split (MČŠP).

Multi-variant analysis of covariance has been used for calculation of effects of the programmed training.

Experimental treatment

Experiment has been carried out in the second semester of 2010/11 school year with pupils of primary schools in the Banja Luka region. Examinees of experimental group, comprised by research, apart from regular teaching of physical education, were involved in the programmed training intended for development of agility and flexibility within the school of skiing for three classes a week in duration of seven weeks in the school section of physical culture. Application of the program of exercises intended for development of agility and flexibility (modified according to Metikoš and co-workers 2003., Nakić 2003, Krsmanović 2009) has been individualized on the basis of abilities and characteristics of examinees for the sake of increase of effective time of training.

Exercises of agility

- mobility of body while standing, circling hips left and right, deflection of the body, circling hips in Eight;
- exercises in pair – pulling the ball, pushing the ball, hops and pulling leg, leaps;
- learning of running from various positions – from lying on the stomach, from lying on the back – forward, from lying on the stomach – forward, turn of 90^{0};
- learning of running with change of direction - running around the pole in the shape of letter T, running around the pole from the middle towards outside, running across the polygon, running around and above over the obstacles;
- learning the reactive reflection in three directions – hops in the polygon with both legs, hops in the polygon with left leg, hops in the polygon with right leg, hops in the polygon with both legs;
- development of agility in the hall – easy running in the place leant on the rip table, leaving one leg behind and lifting the knees, running forward – skip work of arms, running backwards – skip under arm, running laterally – skip work of arms, abduction in the place;
- running from various positions (start from various positions three steps forward): from lying on the back –

ležanja na trbuh - naprijed - okret za 90°, iz ležanja na leđima - naprijed - okret za 90°, iz ležanja bočno, okret za 270° - naprijed - okret za 90°.

Vježbe fleksibilnosti

- pretklon u sjedu sunožnom i raznožnom – istezanje mišića glutealne regije i mišića unutrašnje lože natkoljenice, zadnje lože natkoljenice i potkoljenice;
- istezanje zadnje lože natkoljenice;
- istezanje mišića ramenog pojasa u "mačjoj poziciji";
- preponski sjed – istezanje mišića prednje, unutrašnje i zadnje lože natkoljenice, istezanje mišića lumbalne regije;
- istezanje mišića zadnje lože potkoljenice;
- zanoženje i uzručenje u klečećem položaju – istezanje mišića ramenog pojasapretklon trupa – istezanje mišića glutealne regije i zadnje lože natkoljenice;
- stojeći istezanje mišića ramenog pojasa i grudnih mišića
- zanoženja u stojećem stavu– istezanje kvadricepsa, i mišića pregibača u zglobu kuka;
- istezanje zadnje strane natkoljenice sa partnerom – istezanje mišića zadnje lože natkoljenice i mišića opružača u zglobu kuka.

Rezultati istraživanja

Tabela 1. Multivarijantna analiza kovarijanse u prostoru agilnosti

WILK'S LAMBDA TEST	*.258*
RAO-va F-aproksimacija	*7.97*
Q	***.000***

Tabela 2. Univarijantna analiza kovarijanse u prostoru agilnosti

Testovi / Tests	*Adj.Mean (E)*	*Adj.Mean (K)*	*F-odnos*	*P-Level*
MKOT	*16.08*	*18.70*	*4.46*	***.000***
MKUS	*11.37*	*14.02*	*3.91*	***.000***
MOSS	*10.05*	*13.30*	*6.62*	***.000***
MPON	*11.90*	*13.95*	*7.01*	***.000***
MOKNT	*8.54*	*10.80*	*6.38*	***.000***

U tabeli 1 prikazani su rezultati testiranja značajnosti razlika nivoa aritmetičkih sredina svih testova agilnosti u finalnom mjerenju sa neutralizacijom poda-

forward, from lying on the stomach – forward – turn of 90^0, from lying on the back – forward – turn of 90^0, from lying laterally, turn of 270^0 – forward – turn of 90^0.

Exercises of flexibility

- bend at the seat with both legs and straddle – stretching the muscles of the **gluteal** region and muscles of the inner thigh lodge, hamstrings thigh and lower leg;
- stretching the hamstrings thigh;
- stretching the muscles of the shoulder belt in "feline position"
- inguinal seat – stretching the muscles of the front, inner and hamstring thigh, stretching the muscles of the lumbar region
- stretching the the hamstrings lower leg
- leaving one leg behind and arms up at kneeling position – stretching the muscles of the shoulder belt
- bend of the trunk – stretching the muscles of the gluteal region and hamstrings thigh;
- stretching the muscles of the shoulder belt and pectoral muscles at standing
- leaving one leg at standing position – stretching the quadriceps, and flexor muscle of the hip joint;
- stretching the back of the thigh with a partner – stretching the muscles of the hamstring thigh and the extensor muscle of the hip joint.

Results Of Research

Table 1. Multi-variant analysis of covariance in the space of agility

WILK'S LAMBDA TEST	*.258*
RAO's F-approximation	*7.97*
Q	***.000***

Table 2. Mono-variant analysis of the covariance in the space of agility

Testovi / Tests	*Adj.Mean (E)*	*Adj.Mean (K)*	*F-odnos*	*P-Level*
MKOT	*16.08*	*18.70*	*4.46*	***.000***
MKUS	*11.37*	*14.02*	*3.91*	***.000***
MOSS	*10.05*	*13.30*	*6.62*	***.000***
MPON	*11.90*	*13.95*	*7.01*	***.000***
MOKNT	*8.54*	*10.80*	*6.38*	***.000***

In the table 1 there follows the results of testing the significance of differences of level of the arithmetic means of all tests of agility in the final measurement with

taka na inicijalnom mjerenju između eksperimetalne i kontrolne grupe. Na osnovu vrijednosti Wilk's Lambda testa (.258) i Raove F-aproksimacijom (7.97), utvrđeno je da se ispitanici eksperimentalne grupe statistički značajno razlikuju u nivou agilnosti od ispitanika kontrolne grupe (Q= .000). Pojedinačnom analizom testova agilnosti (tabela 2), može se konstatovati da su utvrđene statistički značajne razlike u svim primjenjenim testovima (koverta test (MKOT .000), koraci u stranu (MKUS .000), osmica sa savijanjem (MOSS .000), poligon natraške (MPON .000) i okretnost na tlu (MOKNT .000).

Tabela 3. Multivarijantna analiza kovarijanse u prostoru fleksibilnosti

WILK'S LAMBDA TEST	*.422*
RAO-va F-aproksimacija	*5.69*
Q	***.000***

Tabela 4. Univarijantna analiza kovarijanse u prostoru fleksibilnosti

Testovi / Tests	Adj.Mean (E)	Adj.Mean (K)	F-odnos	P-Level
MPRD	*38.05*	*35.06*	*10.87*	***.000***
MPZD	*20.32*	*17.35*	*8.89*	***.000***
MSRČ	*34.23*	*32.36*	*9.36*	***.000***
MDPK	*43.36*	*35.36*	*5.10*	***.000***
MČŠP	*34.64*	*26.70*	*6.45*	***.000***

U Tabeli 3 prikazani su rezultati testiranja značajnosti razlika nivoa aritmetičkih sredina svih testova fleksibilnosti u finalnom mjerenju sa neutralizacijom podataka na inicijalnom testiranju između eksperimetalne i kontrolne grupe. Na osnovu vrijednosti Wilk's Lambda testa (.422) i Raove F-aproksimacijom (5.69), utvrđeno je da se ispitanici eksperimentalne grupe statistički značajno razlikuju u nivou agilnosti od ispitanika kontrolne grupe (Q= .000). Pojedinačnom analizom testova agilnosti (tabela 4), može se konstatovati da su utvrđene statistički značajne razlike u svim primjenjenim testovima (pretklon desno (MPRD .000); pretklon, zasuk, dodir (MPZD .000); sjed raskoračni (MSRČ .000); duboki pretklon na klupi (MDPK .000) i čeona špaga (MČŠP .000).

Diskusija i zaključak

Svaka sportska aktivnost u koju spada i skijanje, zahtijeva specifičnu tehničko-taktičku pripremu, što implicira uvid u tendencije njenog razvoja u svijetu, kao i naučni razvoj metoda modeliranja, kako bi se

neutralization of data at the initial measurement between experimental and control group. On the basis of the values of Wilk's Lambda test (.258) and Rao's F-approximation (7.97), it has been determined that the examinees of experimental group statistically significantly differ on the level of agility from examinees of the control group (Q=.000). By use of individual analysis of the tests of agility (table 2), it can be ascertained that statistically significant differences in all applied tests were determined (envelope test (MKOT .000), steps aside (MKUS . 000), eight with bending (MOSS .000), polygon backwards (MPON .000) and agility on the ground (MOKNT .000)).

Table 3. Multi-variant analysis of the covariance in the space of flexibility

WILK'S LAMBDA TEST	*.422*
RAO's F-approximation	*5.69*
Q	***.000***

Table 4. Mono-variant analysis of the covariance in the place of flexibility

In the table 3 there follows the results of significance of differences of levels of arithmetic means of all the tests of flexibility in the final measurement with neutralization of data at the initial testing between experimental and control group. On the basis of values of Wilk's Lambda test (.422) and Rao's F- approximation (5.69), it has been established that the examinees of the experimental group statistically significantly differ on the level of agility from examinees of the control group (Q= .000.). By use of individual tests of agility (table 4), it can be ascertained that statistically significant differences have been determined in all applied tests (bend to the right (MPRD .000; bend, roll-up touch (MPZD .000); seat straddle (MSRČ .000); deep forward bend on the bench (MDPK . 000) and front split (MČŠP .000)).

Discussion And Conclusion

Any sport activity where skiing also belongs, requires a specific technical-tactical preparation which implies insight into tendencies of its development in the world as well as a scientific development by use of

zajednički identifikovao model sportske aktivnosti, a zatim i orijentacija procesa selekcije, rane specijalizacije i svi oblici priprema na odgovarajućim vrijednostima budućeg modela. Takvi generalni zahtjevi podrazumijevaju visoko kvalifikovani trenerski kadar, i kvalitetnu organizaciju rada, posebno sa mlađim uzrasnim kategorijama, zajedničku saradnju i programiranje *(Vongrinec, 1982; Krsmanović, 2006)*.

Opredjeljenje djece i omladine za skijanje uslovljeno je njihovim sopstvenim izborom za ovaj sport, ili selekcijom od strane kompetentnih skijaških stručnjaka. Tek nakon toga procesa počinje proces vježbanja, njihovo vaspitanje u kolektivu i adaptacija na uslove života i rada u klubu *(Lanc, 1988)*. Postoje mnogobrojna istraživanja koja tretiraju razvoj pomenutih, ali i ostalih motoričkih sposobnosti u skijanju *(Krsmanović, 2008; Kuna, Franko i Lozančić, 2010)*.

Osnovni cilj sportskog treninga u skijanju je potpuni razvoj sportista, usmjeren na postizanju najviših mogućih sportskih dostignuća na svakom razvojnom stepenu dugoročne sportske pripreme. To ukazuje da je trenažni proces skijaša usmjeren na razvoj i održavanje svih važnih komponenata treniranosti i sportske forme za optimalni nastup na takmičenjima i postizanje visokih sportskih rezultata. Osim toga, posljednjih godina povećava se i sistemski pristup procesu sportskog usavršavanja ne samo složene strukture spoljašnjih uticaja, već i dinamike procesa zamora i oporavka skijaša.

Na osnovu sprovedenog istraživanja možemo zaključiti da je program treninga za poboljšanje agilnosti i fleksibilnosti u trajanju od sedam nedjelja sa tri treninga nedjeljno ostvario pozitivne efekte kod učenika. Utvrđene statistički značajne razlike između inicijalnog i finalnog mjerenja u svim varijablama govore u prilog uspešnosti primjenjenog trenažnog programa. Dobijeni rezultati su od velikog značaja za trenažnu praksu u skijanju, jer navedene motoričke sposobnosti predstavljaju veoma važne determinante uspeha.

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Konflikt interesa
Mi izjavljujemo da nemamo konflikt interesa.

methods of modeling in order to collectively identify a model of sport activity and then also an orientation of the process of selection, early specialization and all forms of preparation of adequate values of the future model. Such general requirements mean highly skilled trainer personnel and a good organization of work, especially with young population, common cooperation and programming (Vongrinec, 1982; Krsmanović, 2006).

Children's and youth's option for skiing has resulted from their own option for this sport or selection from the competent experts of skiing. Only after that process there begins a process of training, their education in the collective and adaptation to the conditions of life and work in the club (Lanc, 1988). There are numerous researches which treat development of the above-mentioned as well as other motor abilities in skiing (Krsmanović, 2008; Kuna, Franko and Lozančić,2010).

The basic aim of the sport training in skiing is a complete development of sportsmen aimed at performance of the highest possible sport results at every degree of development of a long-lasting sport preparation. It suggests that a training process of skiers aimed at development and maintenance of all important components of being trained and a sport fitness for optimal performance at competitions and accomplishment of high sport results. Besides, in recent years there has been an increase of systematic approach to the process of the sport specialization of the complex structure of the outer impacts as well as dynamics of the process of the process of fatigue and recovery of the skiers.

On the basis of the carried out research we can conclude that the program of training intended for improvement of agility and flexibility in duration of seven weeks with three trainings a week has achieved positive effects at pupils. The determined statistically significant differences between initial and final measurement in all variables speak in favor of success of the applied training program. Achieved results are of a great importance for the training practice of skiing since the mentioned motor abilities present very important determinants of success.

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The authors have contributed equally.

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