Original scientific article
received: 2017-05-30

UDC: 796.926.015

IS SPECIFIC MOTOR TEST ENOUGH TO EVALUATE NEW ALPINE SKI KNOWLEDGE IN SKI BEGINNERS?

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ABSTRACT

The present research aims at determining whether the results of specific motor tests (continuous lateral jumps in dictated tempo − SKILJ) are a sufficient measure to evaluate the level of acquired alpine ski knowledge of ski beginners. Twenty four alpine ski naïve male participants with comparable performance levels and no record of injuries in the preceding six months were included in the study. They were tested on SKILJ test Microgate Optojump Next system prior to participating in a structured alpine ski school program. After completing the ski school program, the participants' knowledge of short turn was tested by five judges. Correlation coefficients between the five judges for the short turn element were all high and statistically significant, implying judges' objectivity in grading alpine ski knowledge. On the other hand, there was no statistically significant correlation between lateral jumps in predefined pace and the acquired knowledge of short turn skiing technique. Therefore, we conclude that the movements executed during alpine skiing with continuous connecting of short parallel turns are much more complicated than the movements needed during the performance of SKILJ which cannot fully depict alpine skiing.

Keywords: *recreational level alpine skiers, motor abilities, motor skills learning efficiency.*

JE PREDLAGANI MOTORIČNI TEST VELJAVEN TEST ZNANJA ALPSKIH SMUČARJEV ZAČETNIKOV?

IZVLEČEK

Cilj raziskave je bil ugotoviti ali rezultati specifičnih motoričnih testov (zaporedni lateralni odskoki po ritmu − SKILJ) omogočajo vrednotenje napredka smučarjev začetnikov pri pridobivanju veščin alpskega smučanja. V raziskavo je bilo vključenih štiriindvajset moških smučarjev začetnikov s primerljivimi sposobnostmi, ki vsaj šest mesecev pred izvedbo raziskave niso bili poškodovani. Preden so se preiskovanci udeležili strukturirane šole alpskega smučanja, smo jih motorično testirali s testom SKILJ (Microgate Optojump Next). Po zaključenem šolanju alpskega smučanja, je skupina petih sodnikov vsakemu preiskovancu ocenila smučanje v ozkem hodniku. Korelacijski koeficienti med ocenami petih sodnikov so bili visoki in statistično značilni, kar nakazuje objektivnost sodnikov pri ocenjevanju. Hkrati pa nismo zaznali statistično značilne povezave med lateralnimi odskoki z definiranim ritmom in pridobljenimi znanji smučanja v ozkem hodniku. Ugotovili smo, da je gibanje, ki ga alpski smučar izvaja med kontinuirano in povezano izvedbo ozkega hodnika mnogo bolj zapleteno kot gibanje med izvedbo testa SKILJ in da slednji ne more v celoti orisati alpskega smučanja.

Ključne besede: *alpski smučarji rekreativci, motorične sposobnosti, učinkovitost motoričnega učenja*

INTRODUCTION

Most of the cyclic sports include the performance of certain rhythmical movements that are systematically repeated. The movements that are repeated in alpine skiing are turns (Oreb, Vlašić, Cigrovski, Prlenda, & Radman, 2011). Effective and meaningful interconnection of individual parts of a turn, as well as connecting multiple turns into a whole represents a skiing rhythm (Cigrovski & Matković, 2015). The rhythmic performance of multiple turns is intuitive performance without any prior thoughts on each part of the turn. The rhythm of the turns, maintaining good balance on the skis, and smooth sliding of the skis all influence our skiing technique, making it more efficient (Loland, 2009; Cigrovski & Matković, 2015). When analyzing competitive level skiers, slalom discipline is the one in which rhythm is often commented with respect to the set course of gates series (Waibel, Huber, & Spitzenpfell, 2009). Slalom turns are short and in a narrow corridor, they are a modified version of short turn element. Although the rhythm of turns is also present in the wider corridor during the technique and in other alpine skiing disciplines, according to Waibel and coworkers (2009), slalom is a

discipline in which oscillations in the change of rhythm during a continuous connection of multiple turns are visible and recorded. From the aspect of recreational skiers, it is known that the success of alpine ski learning depends upon multiple factors, and among the most important are: learning conditions, the expertise of the ski instructor and the abilities and motivation of the ski beginners (Loland, 2009). Although one would expect explosive leg strength to be equally important for beginners as it is for competitive level skiers, tests for its assessment in alpine ski beginners failed to prove correlation with the success of ski learning suggesting that explosive leg strength is not critical in the beginning phases of learning (Neumayr et al., 2003). On the other hand, of all the motor abilities, it is balance that probably differs those ski beginners who will acquire ski knowledge sooner from those whose adoption of ski knowledge will go slower (Malliou et al., 2004; Ružić, Rađenović, & Tudor, 2008; Cigrovski, Franjko, Rupčić, Baković, & Matković, 2016). Interestingly, much less is known about the correlation of coordination in the rhythm with the effectiveness of adopting ski knowledge. It can be assumed that ski beginners who have developed this ability at a higher level will adopt the elements of ski technique that are continuously linked to overcoming the ski terrain more quickly. Currently, the use of simulation devices to improve the motor performances of athletes is becoming increasingly popular. Ski simulators are specifically constructed to enable alpine skiers' adequate conditioning trainings before going to the ski terrains (Straub, 2013). It is expected that ski-simulator training during the off-season, when access to real slopes is limited, would benefit skiers. Existing ski-simulator studies largely verify the training effect through observation of changes in the movement pattern, while only few verify the effectiveness of reality-based ski simulator (Nam & Woo, 2007; Lee, Kim, & Roh, 2012). Moreover, simulation devices are used at recreational level with the purpose to predict the tempo of learning new activity, suggest individual approaches to each beginner, allow people to enjoy skiing during non-winter season and practice ski-turn motor performance (Panizzolo, Marcolin, & Petrone, 2013). With respect to the aforementioned, data on importance of specific motor abilities learned and tested by ski simulator are scarce, but according to Nourrit-Lucas, Zelic, Deschamps, Hilpron, and Delignières (2013), coordination variables tend to be among the most important factors for valid assessment of learning and retention of alpine skiing (Nourrit-Lucas et al., 2013). Skiing is an activity that requires a coordination between upper and lower body, with special accent on leg muscles that need to be strengthened. During ski turns, especially short turns skiers are constantly performing lateral leg movements which are simulated by lateral jumps during training. The use of ski simulators enables lateral movements / jumps to be performed more authentically to short turns. Repetition of lateral jumps or lateral leg movements on a ski simulator represents a certain rhythm that can be performed at different pace, also, the pace at which lateral jumps are performed can be adjusted to usual pace of turns during slalom skiing. Therefore, in the present research we wanted to determine whether the results in specific motor test (continuous lateral jumps − SKILJ) are sufficient to evaluate the level of acquired alpine ski knowledge of ski beginners.

METHODS

Participants

Overall, 24 male participants were included in the study. They were all students of School of Kinesiology, University of Zagreb, who exhibited comparable performance levels and had no record of injuries in the preceding 6 months (age 23.4±1.68 years). They were all ski beginners prior to inclusion in the present study, with no experience whatsoever in alpine skiing. The study was approved by Ethics Committee of the School of Kinesiology, University of Zagreb. Each participant voluntarily provided written informed consent before participating and was thoroughly informed about the study aims and procedures.

Variables

At the beginning, the participants were tested according to a specific SKILJ test, assessing their performance of lateral jumps in dictated tempo (fifteen jumps in a time unit) using Microgate Optojump Next system. The system consists of two bars; transmitting and receiving which communicate by LED lamps and calculate the duration of interruptions in the communication. The calculations measure the flight and contact times during the performance of a series of jumps with an accuracy of 1/1000 of a second. Moreover, the use of two cameras allows recording of the images of the tests performed, synchronizing them with the measured events. The participants were then included in a structured alpine ski program in identical conditions, and were afterwards tested on the short turn alpine ski technique. Short turns best represent the continuous connection of short unfinished parallel turns performed in a narrow corridor.

Research Protocol

The participants were first tested on SKILJ test for motor ability assessment. The test was repeated 3 times and the average result of each participant was used. Two parallel lines 30 cm apart were put on the ground; suggesting a minimal width of lateral jumps. The participants were asked to perform fifteen lateral jumps in the defined space. During the jumps they could use hand swings for the stability and adjusting the tempo of jumps. Intensity of the performance was tested in two variants. In variant one, participants chose their own tempo and intensity for lateral jumps, optimal take off and flight, while in variant two they had to perform 76 lateral jumps per minute (metronome). Variables that were selected and measured included: average contact with ground (contact / s), average duration of flight (flight / s), average power (power W / kg), average value of pace (RSI step / s), average jump height (height / cm).

Figure 1 Participant performing lateral jumps during the testing with Microgate Optojump Next system.

After taking the test, the participants were included in a ten-day alpine ski program. During the skiing program they all had identical conditions regarding the terrains in the ski center, the quality of ski equipment, the hours of daily learning and practice, the availability of ski instructors and the information on alpine skiing. The participants were randomized in three groups of eight, and when the program of alpine skiing finished they all joined one group, demonstrating the acquired knowledge of short turn. Five independent judges graded the demonstration of short turn on a scale from 1 to 5; where the grade 5 was given to participants with superb demonstration. Each grade was given upon previously defined criteria and each judge had to pay attention to a specific part of a turn. Judges' objectivity and homogeneity was tested in previous studies and therefore allowed their engagement in this research (Cigrovski, Matković, & Matković, 2008). Moreover, each participant was filmed during the demonstration of short turn, and afterwards the same judges once again evaluated the video of participants' short turn.

Statistical Methods

The results were analyzed by the Statistica statistical package version 12. To test the objectivity, the correlation coefficients between grades for short turn were calculated. Factor analysis was used to test judges' homogeneity. Basic descriptive parameters were calculated, assessing participants' motor ability (SKILJ). Pearson's coefficients were calculated for the evaluation of degrees of the correlation between motor ability (lateral jumps) and alpine ski knowledge (on-field demonstration of short turn and video analysis of the same element). The results were considered significant if $p<.05$.

Table 1: Correlation coefficients between grades given by five judges for the demonstration of short turn.

	judge 1	judge 2	judge 3	judge 4	judge 5
judge 1	1.00	0.75**	0.80**	0.77**	0.72**
judge 2		1.00	0.79**	0.79**	0.88**
judge 3			1.00	0.82**	0.82**
judge 4				1.00	0.78**
judge 5					1.00

** p<0.05; ** p<0.01*

Correlation coefficients between the five judges for the short turn element are all high and statistically significant, implying judges' objectivity.

Data on judges' homogeneity are presented in Table 2.

Table 2: Results of first components given by judges during the short turn grading.

Element of ski technique	Components (factors)	Eigenvalue	% variance
short turn	1	4.17	83.38

Table 2 presents the eigenvalue of the principal component which fulfils the Guttman-Kaiser criterion (λ=4.17) and represents the knowledge of alpine skiing. The results suggest that all judges participating in the investigation graded the same item, i.e. alpine ski knowledge.

Basic descriptive parameters for the variables obtained in the SKILJ test and for the short turn are shown in Table 3.

Table 3: Basic descriptive parameters for the variables obtained in the SKILJ test and for the short turn.

	N	Mean	Max	Min	SD
SKILJ	24	1.95	1.17	2.41	0.31
short turn	24	3.70	2.00	5.00	1.02
VIDEO short turn	24	1.08	0.93	1.27	0.10
SKILJ avg	24	1.94	1.42	2.35	0.25

SKILJ = continuous lateral jumps; VIDEO short turn =grade for filmed short turn; SKILJ avg =SKILJ average result; Max=maximal; Min=minimal

Correlation between SKILJ test and the level of acquired alpine ski knowledge in short turn is presented in Table 4.

Table 4: Correlation between the SKILJ test and the level of acquired alpine ski knowledge in short turn.

	SKILJ	short turn	VIDEO short turn	SKILJ avg
SKILJ	1.00	0.05	-0.01	0.94*
short turn		1.00	0.11	0.11
VIDEO short turn			1.00	-0.10
SKILJ avg				1.00

** p<0.05; ** p<0.01*
SKILJ = continuous lateral jumps; VIDEO short turn =grade for filmed short turn; SKILJ avg =SKILJ average result

The results show no statistically significant correlation between lateral jumps in predefined pace and the acquired knowledge of short turn ski technique.

DISCUSSION AND CONCLUSION

Alpine skiing is best characterized by repetition of ski turns, the basic motion for managing speed and direction during downhill descend (LeMaster, 2009). It is expected that different exercises or tests simulating specific ski movements used during off-

-season would benefit skiers in terms of training and maintaining their functional and strength capabilities. Significant interest has been shown in the use of motion analysis of ski turns to improve performance while performance of turns affects overall performance (Gwangjae et al., 2016). Although for recreational skiers one would expect similar training might help in learning or mastering specific movements important for ski technique it has not been proven repeatedly. For example, explosive leg strength which is of utmost importance for the success of competitive level skiers, did not show its correlation with success of ski learning during the beginning phases (Neumayr et al., 2003). On the other hand, balance is equally important for competitive skiers as it is for ski beginners, while those who have developed balance at the higher level also adopt ski knowledge more rapidly (Malliou et al., 2004; Ružić et al., 2008; Cigrovski et al., 2016). Although one would expect similar importance of coordination in the rhythm with the effectiveness of adopting ski knowledge, our results failed to demonstrate it with test lateral jumps. Lateral jumps are often used during competitive skiing trainings because they are like lower body and leg motion during skiing. They play a crucial role in the control of speed and direction during turns.

In this study, we found no statistical significance between the results achieved in the SKILJ test (testing lateral jumps) and learned level of short turn. Results suggest that the movements executed during continuous connecting few short parallel turns are much more layered (complicated) than the movements needed during the performance of SKILJ. Moreover, different ways of executing short turns and lateral jumps in the test additionally contributed to a lack of correlation between the two variables. Besides the biomechanical aspects of ski turn that have been studied with different methods and simulators, the analysis of movement helps in determining patterns of injury and subsequently leads to their successful prevention (Lee et al., 2012; Gwangjae et al., 2016). This is where the research with ski simulators is aimed at in the recent years (Lee et al., 2012). As alpine skiing is a specific motor activity primarily due to the conditions in which it is executed and the need for continuous rhythmic body movements while descending the slope in different width corridors, efforts are made in the development of specific training protocols and tests that would improve ski technique. Before making final conclusions about the existence of correlation between the results in SKILJ test and adoption of knowledge in short turn, we need to mention the study limitations. Firstly, it included a small number of participants. In succeeding studies, a larger sample of participants and participants of different age need to be included. If repeatedly one would find no correlation between SKILJ results and alpine ski learning, conclusion with greater certainty would be that we cannot predict success of learning short parallel turn with SKILJ. Once again it must be accentuated that the SKILJ test was taken and modified from conditioning training of the competitive level alpine skiers. Different lateral jumps in dictated tempo are systematically used during conditioning trainings of alpine skiers. Analogy with the mentioned led to the assumption that lateral jumps in predefined tempo of performance like that of short parallel turns will be in close correlation, but as previously mentioned in similar studies, the correlations although sometimes logical, do not always prove in the praxis (Neumayr et al., 2003).

Acknowledgements

The authors are grateful to the HEP (Croatian national electricity company) for supporting the measurements as well as to Microgate and the University of Zagreb for their contributions to this research.

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