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DIFFERENCES BETWEEN MOTOR ABILITIES AND SKILLS IN FEMALE SKI INSTRUCTOR CANDIDATES AND CANDIDATES FOR SKI INSTRUCTOR TRAINEES

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Abstract
To determine the level of motor abilities and specific discrete and serial skiing skills in female ski instructor candidates and candidates for ski instructor trainees, and to test the differences between them, a study was conducted on a sample including 26 female skiers, 10 of which were candidates for ski instructor trainees and 16 were ski instructor candidates. To assess the subjects' basic motor abilities, 8 standard motor measuring instruments were used. To assess discrete motor skills of alpine skiing, the following elements of advanced ski school were used: short slalom curves, dynamic parallel turn and deep snow skiing; whereas to test the serial motor skills, the following tests of competitive efficiency were used:slalom, giant slalom and obstacle course skiing. To test the level of statistical significance of differences between the subjects, *t*-test was used. In the area of motor abilities, statistically significant differences between the subjects were found in figure-of-eight with a bend test and half-squat static hold at the level of $p<0.05$. In the area of discrete motor skills, there were significant differences between the subjects in the timed slalom test at the level of $p<0.05$, and in the area of serial motor skills in the short slalom curves test at the level of $p<0.001$. The higher level of motor abilities and skiing skills incandidates for ski instructor trainees in relation to the ski instructor candidates contributed to the statistically significant differences between the subjects. The obtained results point to the necessity of reconstruction of future selection and ranking of ski instructor candidates and candidates for ski instructor trainees.

Key words: alpine skiing, discrete skiing skills, serial skiing skills, competitive efficiency,motor abilities.

Introduction

Alpine skiing is an activity which, as a sport, requires great physical and psychological exertion from a skier (Cigorovski and Matković, 2009), demanding high level of acquired specific motor skills (Franjko, 2007; Krističević et al., 2010; Kuna 2016): agility, balance, coordination, explosive power and endurance, for which positive correlation with competitive success in alpine skiing has been proven (Bosco, 1997; Reid and Johnson, 1997; Dolenec and Žvan, 2001; Malliou et al., 2004; Emeterio and González-Badillo, 2010; Müller et al., 2011). The competitors' goal in alpine skiing is to, as quickly as possible and with minimum deviation from skiing technique,cross the marked ski run.Given that conditions at each piste are specific and unique, not only due to piste configuration, but also because of the possibility of different setting of the gates (Kostelić, 2005), constant adaptation and correction is needed regarding speed and direction of movement. Besides performance of specific skiing techniques and mastering different types of slopes, alpine skiing includes activities such as turning, climbing, walking and falling, and in realization of all those activities, a skier, skis and poles make a unique system which can function optimally only when individual parts of the system are highly atuned. Depending on the acquisition level of specific skiing skills and rationality of performance, different energy demands and anthropological mechanisms of skiers are engaged (Maleš et al., 2013). Therefore, good skiers require less energy during performance of any ski element, as opposed to the skiers with lower skill level.

The group of specially selected skiers includes ski instructors who, besides expert knowledge, animator, pedagogic and verbal skills, must possess a high level of specific skiing skills and motor-functional abilities to be able to demonstrate ski elements in the best possible manner. Evaluation of skiing skills, i.e., actual quality of ski instructor candidates, represents a complex problem because alpine skiing takes place in special and variable environmental conditions, which additionally hinders the problem of performance of ski elements. Studies that have been conducted in the domain of alpine skiing, and whose subject includes anthropological characteristics of ski instructors, represent a true rarity; however, there have been numerous studies that have investigated this problem directly or indirectly, but on a population of alpine skiing competitiors. Considering that part of Croatian ski instructors used to belong to the population of alpine skiing competitors, and some of them compete even today, the results of testing certain dimensions of anthropological status of ski instructors can be applied even among subject population.

Given that competitive efficiency of alpine skiers integrates relevant skiing skills which play a key role in defining the quality of alpine skiers, it is necessary to construct a model which would be relevant for evaluation of specific skills of ski instructors of all levels. An efficient process of motor learning, correction of mistakes, performance and acquisition of new motor skills is based on extrinsic and intrinsic feedback (Schmidt and Lee, 2005; 2011; Schmidt and Wrisberg, 2008; Coker, 2009). From the training perspective, gathering feedback is done for three main reasons: to correct mistakes, to increase motivation and to reinforce knowledge. From scientific perspective, it is necessary to ensure exact applicability of tests for assessing feedback on motor learning, which is possible only by construction and validation of new measuring instruments which would enable evaluation of the level and quality of specific motor skills. Therefore, for advancement in acquisition and performance of specific skiing skills in ski instructor candidates and candidates for ski instructor trainees, it is necessary to have extrinsic feedback on performance quality, which is usually the cause of success or unsuccessfulness. Extrinsic feedback on performance quality in alpine skiing is a very exact set of information necessary to correct mistakes and raise performance quality. Such information is usually kinematic, describing movement quality, and in the learning process of alpine skiing it is extremely important because it is constructive, it focuses on quality and it might be different than personal, intrinsic performance perception. Considering that skiing skills are classified differently,i.e., one skill integrates others and together they make a whole, serial skiing motor skills such as obstacle course skiing, calibrated and normed, might be a good solution for the problem of the subject.In relation to the aforementioned, the problem of this study is the construction of a measuring instrument that will be the combination of different models of gathering extrinsic feedback, given that in alpine skiing there is no measuring instrument that would integrate feedback on result efficacy and performance quality.

As the level of specific motor abilities and skiing skills in the subgroup of ski instructors and trainees population has not been determined precisely, it would be of great importance for skiing practice to test their values. In relation to the aforementioned, the following objectives were set: a) to determine the level of motor abilities and specific discrete and serial skiing skills in candicates for ski instructor trainees and ski instructor candidates; b) to test the differences between candidates for ski instructor trainees and ski instructor candidates in some motor abilities and discrete and serial motor skills in alpine skiing.

Methods

The subject sample in this study included female skiers, attending the first and second part of specialist education for ski instructor candidates of the Croatian Snow Sports Instructors and Trainers Association. The subject sample can also be called a subgroup of trainees and ski instructors, i.e., their representant defined solely by the level of skiing skills. The testing was done on a sample of 26 female skiers, 10 of which were candidates for ski instructor trainees and 16 were ski instructor candidates. Through general consideration, the structure of motor area of candidates for ski instructors and trainers is defined by complex and demanding activities which the candidates should successfuly realize. Therefore, high-quality and successful performance of specific skiing skills, along with possession of top skiing skill, depends on the level of specific motor abilities. A batery of 8 standard motor measuring instruments was selected to assess basic motor abilities. Considering that activities of ski instructors in the area of motor abilities are largely based on movement structures which require well-developed agility (Dolenec and Žvan, 2001), balance (Müller et al., 2015, Mallliouet al., 2004), psychomotor speed (Neumayret al., 2003) and power, those variables were selected that are best at assessing the aforementioned abilities (Metikoš et al., 1982,

1989;Franjko, 2007). The structure of motor abilities incandidates for ski instructor trainees and ski instructorcandidates was assessed by a battery of 8 standard motor measuring instruments, as follows: to assess agility – Figure-of-eight with a bend (FOEB) and Slalom run (SR); to assess movement frequency – Foot tapping (TAPF); to assess explosive power – Standing broad jump (SBJ); to assess repetitive and static strength – Trunk flexion (TF) and Half-squat static hold (HSSH); to assess balance - Standing sideways on a balance beam with both feet (SSBF) andHopping on a balance beam (HOPB).
The structure of discrete and serial motor skills in alpine skiing was assessed by judges based on videorecordings. Five judges, independently from each other, assessed success for each test on a Five-point Likert scale. The following elements of advanced ski school were analyzed: Short slalom curves (SSC), Dynamic parallel turn (DPT) and Deep snow skiing (DSS). The structure of serial motor skills was tested by the following tests of competitive efficiency:Slalom (SLA), Giant slalom (GSLA) and the newly-constructed Obstacle course skiing (OCS) whose performance skill was also evaluated by the judges.

The study was conduced in Italy during field realization of the first and second part of specialist education for ski instructors, which is organized annually by the Croatian Snow Sports Instructors and Trainers Association. The subjects performed the elements of ski school on the same terrain and in the same conditions, and all performances were recorded, marked and stored to be evaluated later on. The measurement of motor abilities was done in the hotel fitness facilities, which had all the necessary conditions and ensured regular measurement procedure. The forms that had been prepared separately for each subject were filled out by writing down the results. The slalom and giant slalom speed, and the obstacle-course speed were measured by the BROWER instrument in hundreths of a second (1/100 sec). After the measurement, the subjects' forms were filled out by writing down their results. Success in competitive disciplines was assessed by the result of competitive giant slalom and the newly-constructed obstacle-course. The result referred to the result time measured in hundreths of a second (1/100 sec), measured by photocells of the Brower measuring instrument which stops the time the moment the subjects crossess the finish line. The obstacle course wass constructed and set on a groomed ski run with a 30-35% slope, of total length of 220 meters. The starting block of the Brower device was set at the start line, followed by 4 slalom (SL) gates positioned so that the distance from the start to the first gate, as well as distance between any two SL gates, was 10 meters and the angle (in relation to the fall line) 40-45 °. After a 4 GSL gates there were a set of 4 gates which does not belong neither to the SL nor to the GSL technique, but rather this distance unites these two techniques in a way. The subject already has a special task in this part to ski around every gates at one (outside) skis. This was followed by 4 SL vertical gates. The distance from the last gates with a task and the first vertical gates was 15 meters, with a 40-45° angle, with the distance between any two vertical gates being 6 meters, with a 0° angle. After the last vertical gate, at a 6-meter distance, the finish line was set, 10 meters wide, so the middle of the finish line was right below the last gate. The gates were set up using little pins, in such a manner that all slalom gates and all gates with a task were set up by using one pin, and the four giant slalom gates were set up by using two pins.

Methods of dana analysis were chosen in accordance with the aim of the study. Basic descriptive statistical parameters were calculated: mean (M), standard deviation (SD), minimum (MIN) and maximum result (MAX), as well as asymmetry and peakedness of result distribution (SKEW and KURT). Normality of distribution was tested by the Kolmogorov-Smirnov (K-S) test, and cutoff value of the K-S test for each sample size is given below each table. To determine judges' objectivity, the values of Cronbach's alpha coefficient and inter-item correlation were calculated. To analyze the homogeneity of items, eigenvalue of factors (EIGEN)was calculated, as well as the percentage of variance explained by the factor (% VAR). Differences between the trainees and ski instructor candidates in the applied variables was tested by an independent samples t-test.

Results and discussion

By examining Table 1, which presents basic descriptive statistical parameters of motor variables for assessing skiing efficacy of candidates for ski instructor trainees and ski instructor candidates, and variables for assessing discrete and serial motor skills in alpine skiing, it can be noticed that all the applied tests have result distribution which does not deviate significantly from normal distribution. According to the results of the K-S test, there are no variables which would show significant deviation from normal distribution at the level of $p<0.05$. The values of asymmetry and peakednessof result distribution also range within limits of acceptability, thus, it can be concluded that the measuring instrument is good in differentiating the subjects.

Table 1 Descriptive statistical parameters of some motor variables, discrete and serial motor skills in alpine skiing in female candidates for ski instructors (N=16) and ski instructor trainees(N=10).

Ski instructor candidates							
Variables	M	SD	MIN	MAX	SKEW	KURT	D
FOEB	20.00	1.63	17.79	22.85	0.58	-0.91	0.21
SLR	7.88	0.51	7.22	8.79	0.71	-0.58	0.19
TAPF	3.11	1.27	35.00	46.00	0.96	0.96	0.13
SBJ	42.13	2.94	127.00	202.00	-0.84	0.97	0.17
TF	160.06	19.81	20.00	55.00	0.73	0.59	0.16
HSSH	39.00	8.91	13.00	148.00	-0.14	0.21	0.11
SSBF	65.50	33.47	1.30	6.20	0.84	1.15	0.11
HOPB	3.69	1.01	2.00	6.00	0.73	0.45	0.25
SL (s)	25.87	2.68	20.95	31.79	0.52	0.90	0.17
GSL (s)	30.76	2.36	26.47	35.52	0.10	0.27	0.13
OCS (s)	29.01	2.78	24.15	35.24	0.33	0.89	0.16
DSS	2.11	0.72	1.00	3.60	0.50	-0.15	0.14
SL (sk)	2.16	0.66	1.20	3.40	0.33	-0.66	0.13
GSL (sk)	2.39	0.55	1.20	3.40	-0.32	0.71	0.18
OP	2.13	0.61	1.00	2.80	-0.48	-1.12	0.17
SSC	2.09	0.68	1.00	3.20	-0.13	-1.06	0.16
DPT	2.40	0.88	1.00	4.20	0.49	0.54	0.14
OCS (sk)	1.88	0.44	1.40	2.80	0.67	-0.64	0.19
Candidates for ski instructor trainees							
Variables	M	SD	MIN	MAX	SKEW	KURT	D
FOEB	18.65	1.17	16.43	20.08	-0.65	-0.27	0.13
SLR	7.79	0.64	6.60	9.08	0.29	1.95	0.21
TAPF	4.41	2.07	2.50	8.10	0.92	-0.86	0.27
SBJ	42.90	4.01	38.00	50.00	0.52	-0.68	0.17
TF	172.30	12.84	150.00	192.00	0.07	-0.10	0.21
HSSH	45.40	9.25	31.00	57.00	-0.44	-1.31	0.19
SSBF	101.60	55.99	29.00	187.00	0.08	-1.62	0.20
HOPB	4.20	1.75	2.00	8.00	1.17	1.44	0.25
SL (s)	23.20	2.66	19.69	28.20	0.49	-0.34	0.15
GSL (s)	29.18	2.96	24.94	33.66	0.06	-1.19	0.11
OCS (s)	28.42	4.82	21.94	36.03	0.49	-0.84	0.15
DSS	2.14	0.65	1.20	3.80	1.84	5.70	0.37
SL (sk)	2.74	1.24	1.40	5.00	0.78	-0.52	0.17
GSL (sk)	2.80	1.37	1.20	5.00	0.67	-1.11	0.26
OP	2.56	1.15	1.00	4.80	0.62	0.13	0.15
SSC	3.04	1.00	1.80	5.00	0.63	0.23	0.12
DPT	2.42	1.02	1.20	4.40	0.73	-0.15	0.19
OCS (sk)	2.14	0.93	1.20	4.20	1.34	1.47	0.26

Cutoff value of the K-S test for the sample of 16 = 0.34;
for the sample of 10 = 0.43
Legend: M – arithmetic mean; SD – standard deviation;
MIN – minimum result; MAX – maximumresult;
SKEW – measure of asymmetry; KURT – measure of distribution shape;
D – Kolmogorov-Smirnov test.

By examining the results of basic descriptive parameters of basic motor abilities in the population of candidates for ski instructors and ski instructor trainees, and based on the review of previous studies in which the level of anthropological characteristics of female skiers has been investigated (Gorski et al., 2004), it can be concluded that the subjects represent a group of highly recreational skiers. In general, candidates for ski instructor trainees, in relation to ski instructor candidates, have a higher level of motor abilities and specific skiing skills and abilities.Disproportion of the tested abilities and skills is smaller in relation to the ski instructor candidates, which indicates the assumption that it is a homogenous group of subjects which includes a number of skiers who have been more actively involved in the competitive segment of alpine skiing. Similar results can be found in,e.g., soldiers recruits (Maleš, 2004), who can be considered asrepresentative of general population without health abberations, but is extremely heterogenous regarding the levele of anthropological abilities. The situation is probably similar with all other populations which are homogenized based on some other parameters other than the level of basic functional-motor abilities. Namely, if the selection criterion for some population is the health status, or knowledge, and not sports result which implies high level of anthropological characteristics, it is normal for people to be at different levels of psychophysical fitness. Because of this, and based on examination of maximum result values, it can be assumed that candidates for ski instructor trainesss, who generally have better results in all the variables tested, are engaged in a regular training process.

The results of metric characteristics of tests for assessing discrete and serial motor skills according to the dissertation (Franjko, 2013) show good objectivity and reliability of the judges. The values of Cronbach's alpha coefficient and Inter-item correlation, Eigenvalue of the factors and the percentage of variance explained by the factor were calculated. The values of Cronbach's alpha coefficient and Inter-item correlation ranged within the cutoff values of 0.86 to 0.89, and 0.56 to 0.63, which confirms good reliability of the judges. Eigenvalues ranged from 2.95 to 3.75, whereas the percentage of variance explained by the factor ranged from 59 to 70%, which confirms good objectivity of the judges. Based on the obtained results of metric characteristics it can be concluded that the subjects' motor skills were evaluated methodologically correctly and the results obtained are suitable for further dana analyses.

The results of t-test are presented in Table 2 for the testing of statistical significance of differences among means of tests for assessing motor abilities, discrete and serial motor skills in alpine skiing in candidates for ski instructors and ski instructor trainees. By examining the results obtained in the motor abilities variables, statistically significant differences were found in the figure-of-eight with a bend (FOEB) and half-squat static hold (EHS) with the level of statistical significance set at$p<0.05$. In the area of discrete motor skills, there were statistically significant differences among the subjects in the timed slalom test (SLA) with the level of statistical significance set at $p<0.05$, and in the area of serial motor skills in the short slalom curves test (SSC) at the level of $p<0.001$. By further analysis of personal data from the introductory questionnaire filled out by the candidates for ski instructor trainees, it was determined that almost all subjects have been engaged in a systematic training process, given that part of them still actively compete in skiing, and some of them do it occasionally with regular participation of fitness training. That is why their motor abilities, and especially muscle endurance, are maintained at a relatively high level in comparison to the ski instructor candidates. Considering that candidates for ski instructor trainees are also somewhat younger, the obtained results, particularly those regarding their higher agility level, are logical.

Table 2 Differences in motor abilities, discrete and serial motor skills in alpine skiing in female candidates for ski instructor trainees and ski instructor candidates.

	Ski instructor candidates	Candidates for ski instructor trainees		
Variables	M± SD	M± SD	t-test	p
FOEB	20.00±1.63	18.65±1.17	-2.29*	0.03
SLR	7.88±0.51	7.79±0.64	-0.39	0.70
TAPF	42.13±2.94	42.90±4.01	1.99	0.06
SBJ	160.06±19.81	172.30±12.84	0.57	0.58
TF	39.00±8.91	45.40±9.25	1.73	0.10
HSSH	65.50±33.47	101.60±55.99	1.76	0.09
SSBF	3.11±1.27	4.41±2.07	2.07*	0.05
HOPB	3.69±1.01	4.20±1.75	0.95	0.35
SL (s)	25.87±2.68	23.20±2.66	2.49*	0.02
GSL (s)	30.76±2.36	29.18±2.96	1.51	0.15
OCS (s)	29.01±2.78	28.42±4.82	0.40	0.69
DSS	2.11±0.72	2.14±0.65	-0.10	0.92
SL (sk)	2.16±0.66	2.74±1.24	-1.56	0.13
GSL (sk)	2.39±0.55	2.80±1.37	-1.08	0.29
OP	2.13±0.61	2.56±1.15	-1.26	0.22
SSC	2.09±0.68	3.04±1.00	2.90**	0.01
DPT	2.40±0.88	2.42±1.02	-0.05	0.96
OCS (sk)	1.88±0.44	2.14±0.93	-0.98	0.34

Legend: M – arithmetic mean; SD – standard deviation; t-test – coefficient; p – statistical significance level of t-test,
** - statistical significance of coefficient at the level of p<.05;*
*** - statistical significance of coefficient at the level of p<.01.*

Further analysis of the obtained results shows that candidates for ski instructor trainees achieved better results than ski instructor candidates in all the tests assessing skiing skills, even in situational tests, i.e., slalom, giant slalom and obstacle-course skiing, and there were statistically significant differences between the two groups in the timed slalom and short slalom curves test at the level of $p<0.05$.The result of this is the assumption that candidates with more experience, i.e., more skiing days during their lifetime, posses a higher level of skiing skills. This is exactly what happened, but this realization was attained after deep analysis of results and questionnaires. Therefore, a controversy occurred regarding the fact that candidates for ski instructor trainees have more experience and more skiing days, and due to this they possess a higher level of skiing skills. It has been a widely common belief that atendands of the second part of specialty course for ski instructors, given the mere fact that they had already finished the ski instructor trainees course, are those with more skiing days, somewhat older and more experienced, and that they had spent more time on practicing the skiing elements dealt with here, but also technical elements of alpine skiing, before they came to the course. That is why ski instructor candidates are expected to achieve the best results they possibly can in the second part of the specialty course. The examination of the questionnaires showed that out of the 16 ski instructor candidates, 5 are engaged in competitive skiing but on a recreational level, as the number of days skiing per year does not exceed 40 days for either of them. Out of the 10 candidates for ski instructor trainees, 4 have been engaged in competitive skiing recently, 2 of which are candidates at high level, with over 90 days of skiing per year. Therefore, the results presented in Table 2 are logical if viewed in the contex of actual specific skiing engagement, information on which was obtained by the questionnaires. Thus, it can be concluded that the candidates for ski instructor trainees, who have spent more time in a governed skiing exercise process, have automatized skiing skill at a higher level. The obtained results open up the possibility for significant repercusions on future selection and ranking of candidates for ski instructor trainees and ski instructor candidates.

Conclusion

By examining the obtained result values of tests assessing motor abilities and performance of specific discrete and serial motors skiing skills among population of candidates for ski instructors and ski instructor trainees, it can be concluded that the subjects represent a group of highly recreational skiers. By comparing the results, it can be concluded that the candidates for ski instructor trainees, as compared to the ski instructor candidates, possess a higher level of motor abilities and specific skiing skills. The obtained results are opposite from what was expected as it turned out that the subjects with lower ranking ski education possess a higher level of skiing skills and motor abilities as compared to the older, more experienced and higher-ranked candidates. Such an unusal phenomenon occurred because a number of competitive skiiers enrolled the ski instructor traineeseducation so they, due to higher skiing quality, significantly structured the level of skiing skills of the subsample to which they belong. In the area of motor abilities, statistically significant differences between the subjects were found in the figure-of-eight with a bend and half-squat static hold, which points to the conclusion that candidates for ski instructor trainees, in relation to the ski instructor candidates, possess better fitess abilities, especially agility and static strength of the legs. In the area of discrete motor skills, statistically significant differences between the subjects were found in the timed slalom test, and in the space of serial motor skills in the short slalom curves test, which confirms the fact about their higher level of acquired skiing skills. The obtained results can have significant repercussions on future selection and ranking of candidates for ski instructors and ski instructor trainees at the level of skiing skills and abilities of candidates for ski instructor and trainer education course.

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