

# The diagnosis and comparison of physical abilities of skiers and footballers

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## Abstract

**Purpose:** The purpose of this research was to diagnose the physical abilities such as speed, strength, agility and endurance of alpine skiers and footballers through the same country tests. Also, the purpose was to compare the performance and test results of the above tested against one another.

**Material:** The sample of 58 individuals came from two groups of men of different sports: skiing (n = 29) aged 18-26 ( $20.97 \pm 2.08$  years) and football (n = 29) aged 18-25 ( $21, 28 \pm 1.56$  years), while the level in each group was the advanced and the beginner respectively. Until the trials, the ski and football teams had a training program exercising physical abilities and skills three days a week for the specialties and one day a week the select skiing session and the compulsory football session according to the curriculum. In order to diagnose and compare the physical abilities of ski students and football students, the following four tests of Alpine skiing on dry ground were used after the ski season on this day in April 2014: A) Route speed test (route 20m with flight start). B) Explosive power tests of the lower limbs (eightfold with alternating tossing of feet). C) Agility Tests (Slalom's track on a "folder" 5m x 5m). D) Anaerobic test (jumping obstacle 20cm height for 60sec).

**Results:** In the skiing specialty we have a great correlation between speed tests and other physical abilities and agility with endurance ( $r = -0,72$ ). In football specialty there was a great correlation between speed and power tests ( $r = -0,65$ ) and agility with the power ( $r = -0,69$ ). In optional skiing, we have a moderate correlation between the tests, while in the "A" year football students the correlation between speed and strength ( $r = -0,81$ ) is distinguished.

**Conclusions:** It is noteworthy that the students of the first year of football as well as the specialists do not have as good results in endurance as compared to the students of the skiing, even though the football game lasts 90 minutes compared to Alpine skiing 1-2 minutes.

**Keywords:** physical abilities, alpine skiers, footballers, tests.

## Introduction

Several researchers present the issue of diagnosing physical fitness and individual physical abilities through various tests outside the laboratory area, in racing conditions in winter sports e.g. in skiing, and in summer sports e.g. at football. By the term test of the skier (or footballer) we mean the tool that controls and measures the elements of the motor skills and physical abilities of the trainee from the technical or physical standpoint respectively, while the assessment and evaluation is done by the teacher or coach through the test result or "norm" [8]. Alpine skiing requires relatively slow eccentric and concentric movements that produce forces up to 3G, lasting from 40 seconds to over two minutes. As the ultimate control of snow contact and the ability to limit speed distance requires dynamic balance through a wide range of mobility of the lower limbs and hips. Endurance and preparation should focus on hypertrophy, maximal endurance development, balance, dynamic mobility and anaerobic capacity [13]. Soccer is a high-intensity sport that requires players with high levels of aerobic and anaerobic ability, force, velocity, power, skill, coordination and flexibility so as to become competitive [22]. Soccer is characterized by short sprints, rapid acceleration or deceleration, turning, jumping, kicking, and tackling [1, 3, 33] and are directly related with the power production capacity of the neuromuscular system. Soccer players, as well as many other athletes on the

field and the court, execute multiple sprints during the course of a match [20]. The capacity of soccer players to produce varied high-speed actions is known to impact a soccer match performance [18], can be categorized into actions requiring maximum speed, acceleration, or agility [17] and are critical to the outcome of the game. During a typical game, a 2- to 4-second sprint occurs every 90 seconds [2, 23]. Sprinting occupies some 3% of playing time and accounts for 1-11% of the distance covered during a match. Some 96% of sprints are shorter than 30m, and 49% are 10m [15, 26].

### *Purpose of the research*

The purpose of this research was to diagnose physical abilities such as speed, strength, agility and endurance of alpine skiers and footballers through the same country test. Also, the purpose was to compare the performance and test result of the above tested against one another.

By performance, we mean the behavior of the tested person during the test (e.g technique, heart rate, etc.), while top result means the end result.

### *Research questions and assumptions*

The enunciation of the assumptions was based on the following research questions:

- 1) Is there a comparison between alpine skiers and footballers?
- 2) If so, then which tests and physical abilities present the difference?
- 3) Is the difference due to the effect of training or other random factors?
- 4) Is there a criterion for selecting tests that can be a

reliable “simulation” test for skiing or football?

*Delimitation, restrictions and conditions*

The measurements and constraints included in the survey were carried out in the same way: (a) in the same geographical area, in the same weather conditions and at the same time of day; (b) in a sample of individuals with the same characteristics as status, age and sex .

**Material and methods**

*Participants:*

The sample of 58 individuals came from two groups of men of different sports: skiing (n = 29) aged 18-26 (20.97 ± 2.08 years) and football (n = 29) aged 18-25 (21, 28 ± 1.56 years), while the level in each group was the advanced and the beginner respectively.

*The measuring instruments*

In the physical abilities test, the following measuring instruments were used: timer with an accuracy of 0.01 sec, 20 cm height cones and 1 mm precision tape measure.

*Means of data collection*

The following tests are based on the general ICSPFT international test [9, 34] with eight general tests (it was released prior to the Eurofit test [6]) and the Haczkiwicz test [12, 16]. The criterion for selecting a test was the result of the published research or the nominated research, which will answer if the test for skiing is valid and reliable [21, 31] and football [28, 29, 30]. Special tests of dry land in skiing were selected by researchers and authors, who presented the results of some tests with norms [8, 12, 16].

*Measurement procedure*

Until the trials, the ski and football teams had a training program exercising physical abilities and skills three days a week for the specialties and one day a week the select skiing session and the compulsory football session according to the curriculum. The training program included methods and exercises of all forms: general, mimetic on dry ground and snow specific for skiing ([8, 9] and exercises of all forms for football [25]. In order to diagnose and compare the physical abilities of ski students and football students, the following four tests of Alpine skiing on dry ground [8, 9] were used after the ski season on this day in April 2014: A) Route Speed test (Route 20m with flight start). We perform two attempts and count the best. B) Explosive power tests of the lower

limbs (Eightfold with alternating tossing of feet). We make two efforts and measure the distance of the best effort. C) Agility Tests (Slalom’s track on a “folder” 5m x 5m). We are trying to make two consecutive rounds in one attempt. D) Anaerobic test (Jumping of an obstacle of 20cm height by 60sec). We measure the number of repetitions in an attempt (endurance to jumps).

*Statistical analysis*

Planning was implemented, where there were 4 research teams. For all characteristics of the tested, the mean (M) and the standard deviation (SD) were measured. The mean value of the test results per group in the individual tests has been correlated to each other by the following design: Test A with B, A-C, A-D, B-C, B-D and C-D. The statistical analysis was done with the Excel 2007 statistical program.

**Results**

*Analysis of anthropometric data*

The age, sex and the anthropometric characteristics of the ski and football teams that participated in the research are presented in Table 1 and Table 2. In the group of advanced skiers (Table 1) 11 were 22-26 year old specialty students (22,64 ± 1,21 years), height 1,70-2,00m (1,83 ± 0,08) and weight 64-85kg (75,45 ± 7,59), whereas in the group of the beginners, 18 were students 18-23 years of age in the optional course (19,94 ± 1,83 years), 1,62-1,84m (1,76 ± 0,06) and weighing 65-100kg (75,83 ± 9,51).

In the group of advanced football (Table 1), 14 were 22-25 year old specialty students (22,29 ± 0,04 years), height 1.64-1.82m (1,76 ± 0,05) and weighing 56-90 kg (72,07 ± 7,60). The body mass index (BMI) of the skiers had the following values: 24,46 ± 2,45 in the advanced and 22,69 ± 1,87 in the beginners, while the football team of the advanced and the beginners had the following corresponding values: 23,19 ± 1,76 and 23,14 ± 1,87.

*Differences between the physical abilities of skiers and footballers*

*Specialization teams*

In the physical fitness tests and individual physical abilities, the skiing specialty had better results in explosive power (“eightfold”) and anaerobic test (altitude endurance), while football specialty had better results in

**Table 1.** Anthropometric characteristics of skiers and footballers

TEAMS	SAMPLE n	AGE (years)		HEIGHT (m)		WEIGHT (kg)		BMI (kg/ m <sup>2</sup> )	
		M	SD	M	SD	M	SD	M	SD
SPECIALIZATION SKIING	11	22,64	1,21	1,83	0,08	75,45	7,59	24,46	2,45
SELECTION SKIING	18	19,94	1,83	1,76	0,06	75,83	9,51	22,69	1,87
<b>SUM</b>	<b>29</b>	<b>20,97</b>	<b>2,08</b>	<b>1,80</b>	<b>0,08</b>	<b>75,,69</b>	<b>8,69</b>	<b>23,36</b>	<b>2,24</b>
SPECIALIZATION FOOTBALL	14	22,29	0,04	1,76	0,05	72,07	7,60	23,19	1,76
SELECTION FOOTBALL	15	20	1,50	1,79	0,09	74,73	10,53	23,14	1,87
<b>SUM</b>	<b>29</b>	<b>21,28</b>	<b>1,56</b>	<b>1,78</b>	<b>0,08</b>	<b>73,45</b>	<b>9,18</b>	<b>23,16</b>	<b>1,79</b>

speed and agility (Table 2).

In the skiing specialty we have a great correlation between speed tests and other physical abilities and agility with endurance. In football specialty there was a great correlation between speed tests and strength and agility with strength (Table 3).

#### Selection teams

In fitness tests and individual physical abilities, optional skiing had better results in all tests with emphasis on anaerobic test (altitude endurance - Table 4). In optional skiing, we have a moderate correlation between the tests, while in the "A" year football students we can see the correlation between speed and strength (Table 5).

### Discussion

#### Comparison of results between skiers and footballers

In the skiing specialty we have a great correlation between speed tests and other physical abilities and agility with endurance. In football's specialty there was a great correlation between speed tests and strength and agility with strength. In optional skiing, we have a moderate correlation between the tests, while in the A 'year's students the correlation between speed and strength is distinguished. It is noteworthy that the students of the first year of football as well as the specialists do not have as good results in endurance as compared to the students of

the skiing, even though the football game lasts 90 minutes compared to Alpine skiing 1-2 minutes.

#### Comparison of study results with other surveys

##### In skiing:

The performance of alpine skiing is closely related to both aerobic and anaerobic ability. Gross, et al., [10, 11] have investigated the seasonal variation of maximum oxygen uptake and the rate of oxygen uptake among the top skiers. During the racing season, skiers greatly reduce strength training and weight use, while snow training is predominant. In order to substantiate the above assumption, the performance of the top men's athletes has been compared to intensive biking on a ramp, jumps (SJ, CMJ) before and after the racing season. The results of the above study were as follows: 1) the maximum oxygen uptake (VO<sub>2</sub>max) relative to body weight was higher in the pre-racing period ( $55,2 \pm 5,2$  vs.  $52,7 \pm 3,6$  mlkgmin,  $p < 0,01$ ), 2) on the respiratory limit (VT), the absolute and the relative percent of the work was similar, while the heart rate was slower, 3) the height of the jump was higher at SJ, ( $47,4 \pm 4,4$  vs.  $44,7 \pm 4,3$  cm,  $p < 0,01$ ) and in CMJ ( $52,7 \pm 4,6$  vs.  $50,4 \pm 5,0$  cm,  $p < 0,01$ ). Aerobic ability and leg strength were limited to the pre-competitive period and that the improvements observed were mainly due to the mid-competitive recovery from the exhaustion situation in the pre-competitive period. Staying at high altitude in

**Table 2.** Comparison of physical abilities between skiing and football specialization teams

TESTS PHYSICAL ABILITIES (Measurement unit)		SPECIALTIES – STATISTICS' INDEXS						Difference D	Group with improved performance
		SKIING			FOOTBALL				
		M	SD	r (p<0,05)	M	SD	r (p<0,05)		
A	20 m – Speed (sec)	2,83	0,16	A-B = <b>-0,64</b>	<b>2,68</b>	0,25	A-B = <b>-0,65</b>	0,15	Football
B	«Eightfold» – Explosive power (m)	<b>18,60</b>	1,54	A-C = <b>0,70</b> A-D = <b>-0,64</b>	17,93	1,89	A-C = <b>0,43</b> A-D = -0,13	0,67	Skiing
C	Slalom - Agility (sec)	25,11	1,16	B-C = <b>-0,44</b>	<b>23,89</b>	1,42	B-C = <b>-0,69</b>	1,22	Football
D	Jumping 60 sec-Endurance (number of repetitions)	<b>92,73</b>	20,77	B-D = 0,39 C-D = <b>-0,72</b>	73,57	6,24	B-D = 0,26 C-D = -0,39	<b>19,16</b>	Skiing

**Table 3.** Correlation coefficient between tests in ski and football specialization teams

TEST Physical Abilities	SKIING				FOOTBALL				
	Correlation coefficient ( r )				(p<0,05)				
	A Speed	B Strength	C Agility	D Endurance	TEST	A Speed	B Strength	C Agility	D Endurance
A Speed	<b>X</b>				A	<b>X</b>			
B Strength	<b>-0,64</b>	<b>X</b>			B	<b>-0,65</b>	<b>X</b>		
C Agility	<b>0,70</b>	<b>-0,44</b>	<b>X</b>		C	<b>0,43</b>	<b>-0,69</b>	<b>X</b>	
D Endurance	<b>-0,64</b>	0,39	<b>-0,72</b>	<b>X</b>	D	-0,13	0,26	-0,39	<b>X</b>

**Table 4.** Comparison of physical abilities between selection skiing and football teams

TESTS PHYSICAL ABILITIES (Measurement unit)		SELECTION – STATISTICS' INDEXES						Difference D	Group with improved performance
		SKIING			FOOTBALL				
		M	SD	r (p<0,05)	M	SD	r (p<0,05)		
A	20 m – Speed (sec)	<b>2,64</b>	0,21	<b>A-B = -0,44</b>	2,87	0,13	<b>A-B = -0,81</b>	0,23	Skiing
B	«Eightfold» – Explosive power (m)	18,71	1,35	A-C = 0,01 <b>A-D = -0,35</b>	18,33	1,86	<b>A-C = 0,58</b> <b>A-D = -0,36</b>	0,38	Skiing
C	Slalom- Agility (sec)	<b>24,89</b>	1,62	<b>B-C = -0,45</b>	25,91	1,46	<b>B-C = -0,42</b>	1,02	Skiing
D	Jumping 60 sec - Endurance (number of repetitions)	94,54	10,22	<b>B-D = -0,45</b> <b>C-D = -0,47</b>	74,27	6,18	<b>B-D = -0,32</b> <b>C-D = -0,56</b>	20,27	Skiing

**Table 5.** Correlation coefficient between the tests in the selection ski and football teams

TEST Physical Abilities	SKIING				FOOTBALL				
	CORRELATION COEFFICIENT ( r )				(p<0,05)				
	A	B	C	D	TEST	A	B	C	D
	Speed	Strength	Agility	Endurance		Speed	Strength	Agility	Endurance
A Speed	X				A	X			
B Strength	<b>-0,44</b>	X			B	<b>-0,81</b>	X		
C Agility	0,01	<b>-0,45</b>	X		C	<b>0,58</b>	<b>-0,42</b>	X	
D Endurance	-0,35	-0,45	<b>-0,47</b>	X	D	-0,36	-0,32	-0,56	X

the pre-competitive season could also affect the results. Aerobic fitness and leg explosiveness can be maintained during the racing season, but may be jeopardized by heavy or excessive pre-competitive practice.

*At football:*

It is estimated that between 1000 and 1500 discrete movement changes occur within each match at a rate of every 5-6s, having a pause of 3s every 2min [14, 22, 27]. The starting speed (10-15 meters) is a necessary skill in the football game since it assists in claiming the ball, in the unmanned and generally gives an advantage to the appearance of qualitative aggressive and defensive actions, [14]. Surveys show that elite & sub elite players stand out from the amateurs at 10m but not at the speed of 30m [5, 2]. Agility is often recognized as the ability to change direction and start and stop quickly [7] and has been proven as agility performance is a powerful factor that distinguishes them skill levels in soccer [24, 14, 19, 32]. At the high level (Premier League) the players performed the equivalent of 726 ± 203 turns during the match; 609 ± 193 of these being of 0 ° to 90 ° to the left or right [4].

### Conclusions – Proposals

Based on the results of the above survey we can conclude that:

1) It is possible to diagnose and compare the tests in both sports.

2) Skiing Specialization has had better results in explosive power and endurance to jumps, while football specialty has had better results in speed and agility.

3) Selection Skiing has had better results in all tests with emphasis on endurance to jumps.

4) It is remarkable that the students of the “A” year football as well as the specialty do not have as good results in the endurance as compared to the students of the skiing, although the football game lasts 90 minutes compared to Alpine ski 1-2 minutes.

5) Appropriate and documented variety with a wide range of tests may be the test selection criterion that can be a reliable “simulation” test for skiing or football.

### Conflict of interests

The authors declare that there is no conflict of interests.



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**Cite this article as:** Giovanis V, Vasileiou P, Bekris E.. The diagnosis and comparison of physical abilities of skiers and footballers. *Pedagogics, psychology, medical-biological problems of physical training and sports*, 2017;21(5):221–226. doi:10.15561/18189172.2017.0504

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Received: 01.08.2017

Accepted: 25.08.2017; Published: 25.09.2017