

The comparison of physical abilities between alpine skiing skiers' and tennis players

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Annotation:

The aim of the present research was the physical abilities diagnosis of Alpine skiing skiers and tennis players, as well the comparison of these before and after the ski period. The sample of 54 individuals emanated from two teams of different sports: skiing (N = 28) and tennis (N = 26), while the level was advancing for both. For the diagnosis and the comparison of physical abilities used four tests of Alpine skiing on dry ground the same day of December 2008 and April 2009 respectively: 30m flight start, eight continuous jumping, slalom on "folder", jumping up and down on a step with height 40cm x 40sec. The statistical analysis done with SPSS 18 program, included controls t – test, p=bilateral, for dependent samples and correlation analysis at significance level $\alpha = 0.05$ with freedom degrees $df = N - 1$. In conclusion, in the present research the ski team (men and women) presented the improvement afterwards the season in 2 of 4 tests and in the corresponding physical abilities (explosive force, $t = 2.970$, $p < .01$ and agility $t = 3.533$, $p < .00$), while also the tennis team (men and women) presented improvement in 2 of 4 tests (explosive force, $t = 2.397$, $p < .02$ and anaerobic ability, $t = 3.192$, $p < .00$). Finally the common characteristic of the two teams was the performance improvement in the explosive force and their decreased attribution in speed.

Гіованіс Васи́ліус, Котротсіос Степанос. Порівняння фізичних здібностей альпійських лижників і тенісистів. Метою дослідження була діагностика фізичних здібностей альпійських лижників і тенісистів, також порівняння їх до і після лижного періоду. У дослідженні брали участь 54 спортсмени двох команд: лижний спорт (N = 28) і теніс (N = 26), приблизно однакового рівня підготовки. Для діагностики і порівняння фізичних здібностей використовували чотири тести для альпійського лижного спорту на сухій землі в один і той же день – грудень 2008 і квітень 2009 відповідно: біг 30 метрів, вісім безперервних підскоків, човниковий біг, настрибування на висоту 40 сантиметрів протягом 40 секунд. Проведено статистичний аналіз в програмі SPSS 18 для залежних змінних і аналізу кореляційних взаємозв'язків при рівні значущості $\alpha = 0.05$ і міри свободи $df = N - 1$. На закінчення представлені дані в 2 з 4 тестів команди лижників (чоловіки і жінки), які згодом успішніше виступили в сезоні (вибухова сила, $t = 2.970$, $p < 0.01$ і пружність $t = 3.533$, $p < 0.00$), а також дані команди тенісистів (чоловіки і жінки) (вибухова сила, $t = 2.397$, $p < 0.02$ і анаеробні можливості $t = 3.192$, $p < 0.00$). Нарешті в спільній характеристиці двох команд спостерігалось підвищення результатів у вибуховій силі при відповідному зменшенні швидкості.

Гіованіс Васи́ліус, Котротсіос Степанос. Сравнение физических способностей альпийских лыжников и теннисистов. Цель настоящего исследования была диагностика физических способностей альпийских лыжников и теннисистов, также сравнение их до и после лыжного периода. В исследовании принимали участие 54 спортсмена двух команд: лыжный спорт (N = 28) и теннис (N = 26), примерно одинакового уровня подготовки. Для диагностики и сравнения физических способностей использовали четыре теста для альпийского лыжного спорта на сухой земле в один и тот же день – декабрь 2008 и апрель 2009 соответственно: бег 30 метров, восемь непрерывное подскоков, челночный бег, напрыгивание на высоту 40 сантиметров в течение 40 секунд. Проведен статистический анализ в программе SPSS 18 для зависимых переменных и анализа корреляционных взаимосвязей при уровне значимости $\alpha = 0.05$ и степени свободы $df = N - 1$. В заключение, представлены данные в 2 из 4 тестов команды лыжников (мужчины и женщины), которые впоследствии более успешно выступили в сезоне (взрывная сила, $t = 2.970$, $p < 0.01$ и быстрота $t = 3.533$, $p < 0.00$), а также данные команды теннисистов (мужчины и женщины) (взрывная сила, $t = 2.397$, $p < 0.02$ и анаэробные возможности $t = 3.192$, $p < 0.00$). Наконец в общей характеристике двух команд наблюдалось повышение результатов во взрывной силе при соответствующем уменьшении скорости.

Keywords:

alpine skiing, tennis, physical abilities, diagnosis.

альпійський, лижний спорт, теніс, фізичні здібності, діагностика.

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Introduction

The diagnosis of physical abilities in skiing has been the subject of research and study by many scientists, especially abroad. After a brief review of literature, the investigation regarding the physical abilities generally reach the following authors: [6, 18, 20, 25, 27, 28]. The subject of the investigation in skiing reach the writers: [1, 8, 9, 10, 11, 13, 14, 16, 19, 24, 26, 2, 3, 4, 5], and in tennis the writers: [12, 15, 21, 22, 17, 23].

Raschner et al. [19] indicate the three basic requirements in each event of skiing, which concern from one side the status of racing movement, and from the other individual athlete's needs, which are: 1) knowledge of the specific athlete's parameters in a race. 2) select the appropriate test 3) select appropriate training methods and exercises to achieve goals. Skowronski [24] showed changes in the physical abilities of skiers (age $M = 23.3$ years), due to training on dry land and testing before and after the "CAMP" 9 days in the ski resort of Zakopane in Poland. The above researcher noted improvement to explosive power of the legs (test of length jumping from static position) and a reduced ability of speed. Tchorzewski [26] compared the specific ski test "Haczkiwicz" on dry ground with the general test "Eurofit" at the same time.

The investigation had going on character for three years with a frequency of twice a year to students of athletic ski school (aged 15 years old from when the investigation began until 18 years). The students training was 3 hours a day and included training on dry land, in snow, "CAMP" and struggles. The investigator concluded that only two tests of the test – "Haczkiwicz": eightfold from static position and aerobic tests (men 1500m and women 800m) were the criteria for application in practice. The above researcher suggested "Eurofit" test or international test (ICSPFT), or a combination of both. He also suggested creating a directed test (simulation) and a specific test of fitness (e.g. skiing at Rollers and on snow, respectively) for each winter sport. Then suggested the standardization ending with the norms. These tests are criteria for talent selection in skiing and control indicator of fitness during the annual training cycle.

The purpose of this study was to diagnose the physical abilities of Alpine ski skiers and tennis players and to compare them before and after the ski season. The wording of the cases was based on the following research questions: 1) is there improvement in physical abilities among skiers and tennis players after the ski season? 2) if so, what tests and physical abilities have improved? 3) is there a selection tests criterion, which can be reliable

“simulation” tests to ski? 4) is the improvement due to the effects of altitude, in training or other random factors? 5) is there a comparison between alpine ski skiers and tennis players? The measurements and limitations that had included in the research were conducted in the same way: a) in the same geographical area, with the same weather conditions and at the same time of day, b) to a sample of people with the same characteristics, such as status, age and sex.

Methodology

Participants

The sample of 54 persons came from two different groups of sports: skiing (N = 28) and tennis (N = 26), while both teams were at the level of advanced. In the group of skiers (Table 1) there were 20 men and 8 women, aged 20-28 years ($21,75 \pm 1,51$ years), with height 1,55-1,93m ($1,76 \pm 0,10$) and weight 50-93kg ($68,82 \pm 10,71$), while in the tennis team (Table 2) there were 18 men and 8 women, aged 18-25 years ($20,77 \pm 2,07$ years), with height 1,62-1,87m ($1,77 \pm 0,08$) and weight 52-86kg ($70,27 \pm 11,15$). The body mass index (BMI) of the skiers had the following values: 18,34 min – 25,95 max ($22,09 \pm 2,09$), while the tennis team had: 18,91 min – 24,59 max ($22,33 \pm 1,85$).

Data collection

For the diagnosis and comparison of skiers physical abilities and tennis players before and after the ski season were used four tests of the Alpine skiing on dry land [2, 3], on the same day in December 2008 and April 2009 respectively: street 30m with flight start, eightfold from a standstill, slalom on “folder”, jumps on a stepping stone of 40cm x 40sec. The under listed tests are based on general international test (ICSPFT 1977 & 1989) with eight general tests (released prior to application of the test “Eurofit” -1991) and the test “Haczkiwicz” [9, 10]. The selection criterion for a test was the result of the published research or the candidate research which will tell us whether it is valid and reliable test for ski (see the introduction: [24, 26, 19]). Specific tests of alpine skiing on dry land selected by researchers and writers, who presented the results of some tests with norms. These tests were as follows [2, 3]: 1) free running speed test, 30m road with flight start (perform two attempts and counting the best), 2) explosive power of legs test, eightfold with simultaneous ejection of two feet from a standstill (perform two attempts and measures the distance of the better effort), 3) agility test, slalom route on “folder” (perform two attempts and counting the best), 4) anaerobic test, side jumps on a “step” of 40cm for 40sec (we count the number of repetitions in an effort).

Data collection process

At the eve of the skier team at sea level (up to early December) they had exercise training program of all physical abilities three days a week. The program included all kinds of training methods and exercises, i.e. general and mimic on dry ground [2, 3]. For the practical part of the course-training the same skiers were at Parnassos Ski Center at an altitude of 1750-2300m. While staying in Arachova they were at an altitude of 1050m. The length of staying in the mountain was from 10 January to 10 April

and specifically three consecutive days each week. The program included training methods and specific exercises at snow [2, 3]. The tennis team remained at sea level all the time (before, during and after winter). They had exercise training program of all physical abilities three days a week. The program included all kinds of training methods and exercises, i.e. general and special court.

Design

Factorial design (2 X 2 X 2) was applied, where there were two research teams, two measurements before and after the ski season with the last factor of gender (men and women) to be repeated.

Statistical analysis

Statistical analysis was performed with the statistical program SPSS 18 and applied the comparison of two samples correlated values: 4×2 (four test groups x two measurements: before and after the ski season), included t – test, p = bilateral, for dependent samples and correlation analysis at significance level $\alpha = 0.05$ with freedom degrees $df = N - 1$. The statistical indicators presented in the tables below were: mean (M), standard deviation (SD), standard error (SE) difference in average (D). In this research prerequisite to be valid this test is the t – index to be greater or the same to the value of the criterion (t_c) of the t – test. Also it was tested the null hypothesis, i.e. after the ski season there would be improve to the performance of 4 separate trials, and therefore the corresponding physical abilities.

Results

Demographics of participants

Age, gender and somatometric characteristics of skiing and tennis groups in the study are presented in Table 1 and 2.

Improving the physical capacity of the Alpine skiers

After the ski season the difference (D) results was not statistically significant. Control t – test rejected the null hypothesis and showed performance improvement in most tests (Table 3, 4), where men have statistical improvement in only 1 of the 4 tests (agility tests – Slalom on “folder”: $t = 2.263$, $p < .04$, while also in women the control t – test showed improvement in only 2 of 4 tests: (explosive power test – “eightfold”, $t = 2,911$, $p < .02$ and agility tests – slalom on “folder”: $t = 3.165$, $p < .02$). Finally, the total group of men and women skiers have shoed statistically improvement in 2 of 4 tests: (explosive power test – “eightfold”, $t = 2,970$, $p < .01$ and agility test – slalom on “folder”: $t = 3.533$, $p < .00$).

Improving the physical capacity of tennis players

After the ski season the difference (D) results was not statistically significant. Control t – test rejected the null hypothesis and shoed performance improvement in most tests (Table 5, 6) where men shoed statistically improvement in 2 of 4 tests («explosive power test – eightfold», $t = 3.137$, $p < .01$ and “anaerobic test – jumps», $t = 3.167$, $p < .00$, while in women control t – test showed no statistical improvement. Finally, the total tennis group of men and women shoes statistically improved in 2 of the 4 tests: («explosive power test- eightfold», $t = 2,397$, $p < .02$ and «anaerobic test-jumps» $t = 3.192$, $p < .00$).

Table 1

Somatometric characteristics of skiers who participated in the tests before and after the ski season

SKIERS (N)	MEN (N=20)		WOMEN (N=8)		TOTAL (N=28)			
	M	SD	M	SD	M	SD	MIN	MAX
AGE	21,75	1,77	21,75	0,46	21,75	1,51	20	28
WEIGHT (kg)	74,05	7,21	55,75	5,28	68,82	10,71	50	93
HEIGHT (m)	1,80	0,08	1,67	0,07	1,76	0,10	1,55	1,93
BMI (kg/ m ²)	22,89	1,60	20,11	1,90	22,09	2,09	18,34	25,95

Table 2

Somatometric characteristics of tennis players who participated in the tests before and after the ski season

TENNIS PLAYERS (N)	MEN (N=18)		WOMEN (N=8)		TOTAL (N=26)			
	M	SD	M	SD	M	SD	MIN	MAX
AGE	20,44	1,85	21,5	2,45	20,77	2,07	18	25
WEIGHT (kg)	77,11	4,34	54,88	2,64	70,27	11,15	52	86
HEIGHT (m)	1,81	0,04	1,66	0,02	1,77	0,08	1,62	1,87
BMI (kg/m ²)	23,43	0,80	19,85	0,73	22,33	1,85	18,91	24,59

Table 3

The physical abilities comparison of skiers team, men (N = 20) and women (N = 8), before and after the ski season 2008-2009

YEAR	TESTS - PHYSICAL ABILITIES (Measurement unit)	SEX	STATISTICAL INDICATORS							
			BEFORE			AFTER			VARIATION	CONTROL t – test
			M	SD	SE	M	SD	SE	D	t, p =bilateral, p < .05
2008-09	30m – speed (sec.)	A	3.79	.17	.04	3.83	.16	.04	-.04	p > .05
		Γ	4.62	.22	.08	4.50	.38	.13	.12	p > .05
	“eightfold” – explosive force (m)	A	18.79	1.45	.33	19.21	1.40	.31	.42	p > .05
		Γ	13.61	.76	.27	14.70	1.13	.40	1.09	t = 2.911, p < .02
	slalom – agility (sec)	A	12.48	.52	.12	12.20	.52	.12	.28	t = 2.263, p < .04
		Γ	13.71	.61	.22	12.74	.57	.20	.97	t = 3.165, p < .02
jumps 40 sec (repetitions num.)	A	44.9	7.03	1.57	47.65	5.63	1.26	2.75	p > .05	
	Γ	36	7.75	2.74	37	5.86	2.07	1	p > .05	

Table 4

The physical abilities comparison of overall skiers team, men and women (N = 28), before and after the ski season 2008-2009

YEAR	TESTS - PHYSICAL ABILITIES (Measurement unit)	SEX	STATISTICAL INDICATORS							
			BEFORE			AFTER			VARIATION	CONTROL t – test
			M	SD	SE	M	SD	SE	D	t, p = bilateral, p < .05
2008-09	30m – speed (sec)	A + Γ	4.03	.42	.08	4.02	.39	.07	.01	p > .05
	“eightfold” – explosive force (m)	A + Γ	17.31	2.71	.51	17.92	2.45	.46	.61	t = 2.970, p < .01
	slalom – agility (sec)	A + Γ	12.83	.78	.15	12.35	.58	.11	.48	t = 3.533, p < .00
	jumps 40 sec (repetitions num.)	A + Γ	42.36	8.19	1.55	44.61	7.43	1.40	2.25	p > .05

The physical abilities comparison of tennis team, men (N = 18) and women (N = 8), before and after the ski season 2008-2009

YEAR	TESTS - PHYSICAL ABILITIES (Measurement unit)	SEX	STATISTICAL INDICATORS							
			BEFORE			AFTER			VARIATION	CONTROL t – test
			M	SD	SE	M	SD	SE	D	t, p = bilateral, p < .05
2008-09	30m – speed (sec)	A	4.39	.98	.02	4.39	.12	.03	.00	p > .05
		Γ	4.78	.20	.07	4.79	.16	.06	-.01	p > .05
	“eightfold” – explosive force (m)	A	16.77	1.39	.33	16.86	1.36	.32	.09	t = 3.137, p < .01
		Γ	12.71	.64	.23	12.71	.59	.21	.00	p > .05
	slalom – agility (sec)	A	12.15	.68	.16	12.16	.71	.17	-.01	p > .05
		Γ	13.07	1.16	.41	12.97	1.08	.38	.10	p > .05
	jumps 40 sec (repetitions num.)	A	38.06	1.92	.45	38.72	1.81	.43	.66	t = 3.167, p < .00
		Γ	30.25	2.915	1.03	30.75	1.91	.67	.50	p > .05

Table 6

The physical abilities comparison of overall tennis team, men and women (N = 26), before and after the ski season 2008-2009

YEAR	TESTS - PHYSICAL ABILITIES (Measurement unit)	SEX	STATISTICAL INDICATORS							
			BEFORE			AFTER			VARIATION	CONTROL t – test
			M	SD	SE	M	SD	SE	D	t, p = bilateral, p < .05
2008-09	30m – speed (sec)	A + Γ	4.51	.23	.04	4.51	.23	.05	.00	p > .05
	“eightfold” – explosive force (m)	A + Γ	15.52	2.26	.44	15.59	2.27	.45	.07	t = 2.397, p < .02
	slalom – agility (sec)	A + Γ	12.43	.94	.18	12.41	.90	.18	.02	p > .05
	jumps 40 sec (repetitions num.)	A + Γ	35.65	4.29	.84	36.27	4.16	.82	.62	t = 3.192, p < .00

DISCUSSION – CONCLUSIONS

Skowronski [24] to his investigation he observed improvement to the explosive strength of legs and reduced ability of speed, while to the present study we had similar effects only in the total group of men in all ages. Tchorzewski [26] observed that only the two tests of the test – “Haczkiewicz” were the criteria for application in practice means: “eightfold” from standstill and aerobic test (1500m men and 800m women). Giovanis and his colleagues [5] found that four of eight tests showed improvement after the ski season in men (eightfold, balance on the right foot, slalom and endurance 1000m) and respectively in women (balance on the right foot, dips into the parallel bars, static endurance at force of 2 feet and endurance of 600m). In overall and mixed men and women group there was improvement in 6 of the 8 tests. In conclusion, in this research skiing team (men and women) showed the improvement after the season time on 2 of the 4 tests and the corresponding physical abilities (explosive strength and agility), while also the tennis team (men and women) showed the improvement on 2 of the 4

tests and the corresponding physical abilities (explosive power and anaerobic ability).

The statistical validation (t – test) can lead to optimal diagnosis as a criterion for the test selection, as it did not reject the null hypothesis and showed for the total group of two sports men and women improvement in 2 of the 4 tests respectively. The valid choice of the test allows optimization diagnosis of trainer’s physical abilities. It implies the talent selection, the assessment of individual preparation and trainer development level.

The performance improvement of the Alpine skiers team in “agility” compared with the tennis team may be due to the effects of altitude because of staying [4] and acquired slalom exercises in the training, while the performance improvement of tennis team in anaerobic ability compared with the group of Alpine skiers may be due to the greater during effort of the sport. Finally, the common feature of the two teams was the improvement to the “explosive power” performance and the reduced performance in “speed”.

References:

1. D'urbanos G. *Sci Competition*. Milan, Sperling & Kupfer Editor, Milan, 1991, 200 p.
2. Giovanis V. *Training of Alpine Skiing* [Proponitiki sti chionodromia katavaseon]. Athens, 1989, pp. 283-286.
3. Giovanis V. *Technique of Skiing* [Techniki tis chionodromias], Athens, 2006, pp. 207-208.
4. Giovanis V., Tikos K. & Giovani Ch. *The effect of training in altitude to physical ability of students with speciality on skiing*. 14th International Congress of Physical Education and Sport, Komotini, 19-21 May, 2006, p. 241-242.
5. Giovanis V., Amoutzas K., Giovani Ch., Tikos K., Mantis K. The optimisation of diagnosis of physical ability of skiers alpine skiing. Exercise and Society: *Journal of Sport Science*, 2008, vol. 12, pp. 78-82.
6. Goodsell A. *Your personal trainer*. Boxtree Limited, Broadwall House, London, 1994, p. 25.
7. Grabowski H., Szopa J. *EUROFIT-The European test of physical fitness* [EUROFIT – Europejski test sprawnosci fizycznej]. Krakow, APE, Publishing house, 1991, vol.13, pp. 45-50.
8. Grosser M. & Starischka St. *These are the tests for athletes* [Afta ine ta test gia athlites]. Ekdoseis: Alkion, Athens, 1983, 240 p.
9. Haczkiewicz B. Measuring physical efficiency of junior skiers [Pomiar sprawnosci fizycznej narciarzy juniorow]. *Physical Education and Sport*, 1976, vol.12, pp. 57-63.
10. Krasicki S., Majoch T., Tokarz L. *Cross-country skiing. Training Program for Children and Youth* [Biegi narciarskie. Program Szkolenia Dzieci i Mlodziezy]. Warsaw, Department Methodical Center – Preparatory Physical Education and Sport, 1995, pp.113-118.
11. Kratter G. & Marta E., *Sci Para Jovenes. Method to progress in the competition*. Madrid, 1992, 280 p.
12. Kraemer J. William, Ratamess Nicholas, Fry C. Andrew, Triplett-McBride Travis, Koziris L. Perry, Bauer A. Jeffrey, Lynch M. James and Fleck J. Steven J. Influence of Resistance Training Volume and Periodization on Physiological and Performance Adaptations in Collegiate Women Tennis Players. *The American Journal of Medicine & Sports*, 2000, vol.28(5), pp. 626-633.
13. Mester J. *Stimuli and stimulation: Hypoxia and mechanics*. Ed: Muller E. et al., Abstract Book of the 4th International Congress on Science and Skiing. University of Salzburg, December 14-20, St. Christoph am Arlberg, Austria, 2007, p.28-34.
14. Mondadori O. *Super guidance for sport*. Milan. 1986, 179 p.
15. Muller Erich, Benko Ulrike, Raschner Christian, Schwameder Hermann. Specific fitness training and testing in competitive sports. *Medicine & Science in Sports & Exercise*, 2000, vol.32(1), p. 216-222.
16. Pernitsch H. & Saudacher A. *Teaching of alpine skiers*. Bases of section. Series of technical lectures Ski Federation, Innsbruck. 1998, 240 p.
17. Perry C. Arlette, Wang Xuewen, Feldman B. Brandon, Ruth Tiffany, Signorile Joseph. Can Laboratory-Based Tennis Profolders Predict Field Tests of Tennis Performance? *Journal of Strength & Conditioning Research*, 2004, vol.18 (1), pp. 136-143.
18. Pilicz S. Measurement of overall physical performance [Pomiar ogolnej sprawnosci fizycznej]. *Studios and monographs*, Academy of physical Education, Warsaw, 1997, vol.65, pp. 32-72.
19. Raschner Ch., Patterson C., Puhlinger R., Platzer H – P. Special Tests at Alpine Skiing [Testy specjalne w narciarstwie alpejskim]. *Sport of Exploit* [Sport Wyczynowy], 2004, vol.5-6, pp. 473-474
20. Raczek J. *Fundamentals of sports training of children and youth* [Podstawy Szkolenia sportowego dzieci i mlodziezy]. Library of trainer. Physical Kultura and Sport, Warsaw, 1991, pp.25 -31.
21. Roetert, E. Paul, Brown W. Scott, Piorkowski A. Patricia, Woods B. Ronald. Fitness Comparisons Among Three Different Levels of Elite Tennis Players. *Journal of Strength & Conditioning Research*, 1996, vol.10 (3), pp. 139-143.
22. Roetert E. P. & Ellenbecker T. S. *Complete Conditioning for Tennis*. Human Kinetics, Champaign, Illinois. 1998. 240 p.
23. Salonikidis Konstantinos, Zafeiridis Andreas. The Effects of Plyometric, Tennis-Drills, and Combined Training on Reaction, Lateral and Linear Speed, Power, and Strength in Novice Tennis Players. *Journal of Strength & Conditioning Research*, 2008, vol.22(1), pp. 182-191.
24. Skowronski W. Motor Efficiency up to international representatives of the Polish Olympic Winter Special Olympics in Anchorage [Sprawnosci motoryczna reprezentantow Polski na swiatowe zimowe Igrzyska Olimpiad specjalnych w Anchorage], *Scientific notebooks [Zeszyty naukowe]*, 2001, vol.84, pp. 100-106.
25. Talaga J. *ABC of Young Player. Teaching techniques* [ABC Mlodego pilkarza. Nauczanie techniki]. Poznan, Income and S-ka Publ., 2006, p.36-40.
26. Tchorzewski D. *Attempt to verify the efficiency of a special test at an angle Haczkiewiczza its relevance* [Proba weryfikacji testu sprawnosci specjalnej Haczkiewiczza pod katem jego trafnosci]. *Studia i monografie [Studios and monographs]*, Krakow, APE Publ., 2005, vol.31, pp. 131-137.
27. Trzesniowski R. & Pilicz S. *Tables of physical fitness of young people aged 7-19 years* [Tabele sprawnosci fizycznej mlodziezy w wieku 7-19 lat], Warsaw, APE Publ., 1989, 212 p.
28. Zak S. *Tables of international test scores in physical function (ICSPFT) for youth aged 12 – 18 years* [Tabele punktacji miedzynarodowego testu sprawnosci fizycznej (ICSPFT) dla mlodziezy w wieku 12 – 18 lat]. Krakow, 1977, pp 7-14.

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