SECTION – EXERCISE SCIENCES

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COMPARISON OF COMPREHENSIVE EFFICIENCY OF GIRLS ENGAGED IN DIFFERENT WINTER SPORTS

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Abstract:

Aim. The aim of the study is to compare the level of selected motor skills of candidates for the High School of Sports Championship (LO ZSMS) in Zakopane, representitives of different winter sports (biathlon, speed-skating, cross-country skiing and alpine competitions).

The following research questions were put forward:

1. Do the studied groups, representing individual winter sports disciplines, differ from each other in terms of somatic build?
2. How does the differentiation of energy-based ability levels (strength, speed and endurance) develop among the groups, and do the female representatives of the various disciplines achieve the best results in terms of their leading motor skill?
3. Is the nature of the sport discipline reflected in the diversity of the level of coordination abilities in the studied female athletes?

Basic procedures. The study involved 74 girls, candidates for LO ZSMS Zakopane representing: biathlon, speed-skating, cross-country skiing and alpine competitions.

Based on trails from the Eurofit battery of tests and the International Physical Fitness Test, the level of energy-based motor ability was determined (strength, speed and endurance). Coordination capacity, i.e.: time-spatial orientation, motor reaction speed and balance were determined using apparatus based tests.

Before beginning measurements, we evaluated the basic anthropological characteristics of the subjects.

Results. There were statistically significant differences between the two groups in terms of energy-based abilities: strength (strength of abdominal muscle mm. $p = 0.049$, strength of functional arm mm. $p = 0.004$) and endurance (Harvard Step-up Test $p = 0.034$, 800-m run $p = 0.000$, endurance shuttle run $p = 0.008$). Among the examined coordination abilities, differences were only found in the equivalent test in the frontal plane ($p = 0.500$)

Conclusions. Among the studied winter sports representatives, no statistically significant differences in somatic build were found.

As expected, the level of energy-based motor skills differentiates the studied groups and the found disparities are a consequence of performing different disciplines.

There were no differences between the groups in terms of reaction time or time-spatial orientation. Such differences occurred in the case of balance in the frontal plane, which was dominated by representatives of the alpine competitions and biathletes.

Introduction

to meet the demands of modern professional sport, competitive candidates of most disciplines must be characterized by good health, proper body structure and the highest level of motor skills which determine success in competition. Hence the need to look for candidates who can meet these expectations. The requirements placed upon the adepts of winter sports are additionally increased due to the particularity of these disciplines related to severe weather conditions and slippery, often unstable surfaces [1, 2].

One of the most important challenges that a coach must face during the training process is the ability to determine the proper level of motor skills at different stages of player development. This is particularly important in disciplines based largely on the capacities of energy. It is much harder to determine the level of technical progress. Despite the modern measurement technology, the basic research tool in this case is still observation, however, supported by different audiovisual possibilities.

Motor efficiency in humans, or more broadly, physical fitness, being the indicator of development and health, is a primary subject of physical culture studies in numerous research papers. Measurement and evaluation of a person's physical fitness has been the source of numerous discussions for many years, which we can find reflected in the rich literature and a large number of proposals of various tests [3, 4].

In Poland, the most common tool for measuring motor performance is the International Physical Fitness Test and the European Physical Fitness Test - Eurofit [5]. They have been the subject of numerous studies and most importantly, were standardized in relation to the national population [6-8]. The battery of tests has been designed so that its implementation does not require specially acquired motor skills. In contrast to the International Test, Eurofit also includes attempts to diagnose the area of coordination of motor abilities (CMA) evaluating balance and speed as well as frequency of movements.

In the practice of sports training, it is impossible to separate the formation of different groups of motor skills. It is difficult to find a natural form of movement, which would be shaped for example, by endurance without the elements of strength or coordination. However, the training process can be steered in such a manner as to shape a specific motor ability to be dominant.

In order to systematize motor skills, they were divided into four groups: strength, speed, endurance and coordination. [9] It was also in these groups that we carried out the research and described its results.

In each sport, we can distinguish leading motor skills, which are the most specific for a given discipline. In cross-country skiing, the biathlon and long-distance speed-skating, the outcome is mainly determined by endurance, that is the body's ability to carry out long-term muscle work at a certain intensity with no signs of fatigue [10-12]. While for downhill skiing, speed, strength and coordination abilities are crucial [13-15].

The process of recruitment and selection in sport, in addition to targeted and specific tests, comprehensive fitness test should also be used, and above all, the level of leading motor abilities for the given discipline or competition should be determined on the basis of their results [16]. However, this requires the designation of a reference level, which is usually untrained youth [17]. However, the differences in physical fitness between athletes and the population are so significant that they often blurs the real image. Therefore, the aim of this work is comparison of the level of selected motor abilities based on comprehensive efficiency tests of competitors, candidates for the High School of Sports Championship (LO ZSMS) in Zakopane, practicing different winter sports (cross-country skiing, the biathlon, speed-skating and alpine competitions).

The following research questions were put forward:

1. Do the studied groups, representing individual winter sports disciplines, differ from each other in terms of somatic build?
2. How does the differentiation of ability levels of energetic nature (strength, speed and endurance) develop among the groups, and do the female-representatives of the various disciplines achieve the best results in terms of their leading motor skill?
3. Is the nature of the sport discipline reflected in the diversity of the level of coordination abilities in the studied female-athletes?

Material and methods

Study group

The study used the fitness test results of Zakopane LO ZSMS candidates. The study group consisted of 74 girls practicing disciplines such as the biathlon (19), speed-skating (14), cross-country skiing (29) and alpine competitions (12). By alpine competitions we mean a group of downhill skiing and snowboarding representatives. The need to combine these related disciplines resulted from the insufficient number of representatives in recruitment tests for LO ZSMS. The detailed characteristics of the studied girls divided according to their practiced discipline are shown in Table 1.

Research procedure

The study included measurements of morphological-structural predispositions and motor skills. When measuring motor skills, we considered: strength, speed, endurance

Table 1. Basic somatic characteristics of the studied female athletes of individual sports ($\bar{x}$, s)

Group	n	age [years]	body height [cm]	body mass [kg]	BMI [kg/m^2]
biathlon (BH)	19	16.0 (0.58)	162.17 (5.82)	53.72 (6.30)	20.39 (1.73)
speed-skating (SS)	14	15.8 (0.38)	164.91 (8.87)	58.14 (7.92)	21.28 (1.20)
cross-country skiing (CCS)	29	15.9 (0.28)	164.26 (5.67)	56.54 (6.84)	20.92 (1.90)
alpine competitions (AC)	12	16.0 (0.84)	164.67 (7.35)	59.13 (12.7)	21.80 (4.32)

and coordination. The measurement of morphological-structural predispositions comprised of: body height, body mass, fat-fold thickness (arm, shoulder, abdomen) and agility. Body Mass Index (BMI) was also determined on the basis of these results.

Most of the performed motor tests came from the International Test [7] and Eurofit [5]. Due to the fact that the tests were also the recruitment procedure for LO ZSMS in Zakopane, the selection of fitness tests, as in the case of other sports schools, was partly dictated by MSiT.

The following tests were performed within the studied groups of skills:

1) Strength capacity: sitting from lying position, dynamometric measurement of hand strength, overhang, pull-ups.
2) Speed capacity: standing long-jump, 50-m run, agility shuttle run 4x10 m, envelope run.
3) Endurance capacity: Harvard Step-up Test, 800-m endurance run, endurance shuttle run.
4) Coordination capacity:
   a) time-spatial orientation: test using Piorkowski-type machine (time - one minute, stimuli emission - 107/min.), visual-motor tester (free series, stimuli emission - 49).
   b) reaction speed: test using reaction time to visual and auditory stimuli.
   c) balance: test on "Libra" balance platform. 6th degree of difficulty ($\pm$5°). The path of movement was represented by a sine wave with an amplitude of 5° and a frequency of 10 cycles/min. The value of the stability index was used for analysis [18].

All of the subjects performed the tests on one day in standard conditions.

Data analysis

In order to answer the research questions, the results of measurements were assessed using common methods of descriptive statistics. Basic numerical characteristics of the studied variables, which are the arithmetic mean ($\bar{x}$), standard deviation (SD) of the minimum (min) and maximum (max) values were determined for both groups.

In the case of the absence of normal distribution of some of the analyzed variables, confirmed using the Shapiro-Wilk test, non-parametric tests were used in subsequent analyzes.

For the purpose of determining the significance of differences between the groups, we used the Kruskal-Wallis test, which is an extension of the Mann-Whitney U test when comparing more groups. After finding a statistically significant difference regarding the tested variable between the groups, post hoc multiple comparisons were performed.

Calculations were performed using the STATISTICA 10.0 program.

Results

Morphological-structural differences in athletes of individual sports

Body composition is one of the factors co-determining the level of motor performance. Its components are an important part of morphology, conditioning current and potential sport achievements.

Testing the morphological-structural predispositions of winter sports athletes, we measured their body height, body mass, thickness of three fat folds, agility and Body Mass Index (BMI). The results are shown in Table 2.

The results obtained on the basis of the Kruskal-Wallis test do not demonstrate the presence of significant differences regarding the tested somatic characteristics. The sports performed by the athletes at the stage of targeted training did not significantly affect the changes in their body build.

Comparing the level of strength capacity

The tests regarding strength capacity performed during the study were aimed at determining its level in relation to the upper limb girdle (overhang, pull-ups), the

Table 2. Comparing morphological-structural predispositions of female athletes of individual winter sports

discipline	statistics	body height [cm]	*p* *(F)*	body mass [kg]	*p* *(F)*	BMI	*p* *(F)*	total of 3 fat folds [mm]	*p* *(F)*	agility [cm]	*p* *(F)*
BH	$\bar{x}$	162.17		53.72		20.39		36.79		61.21	
	s	5.82		6.30		1.73		17.42		4.67	
SS	$\bar{x}$	164.91		58.14		21.28		34.86		56.29	
	s	8.87		7.92		1.20		16.36		18.81	
CCS	$\bar{x}$	164.26		56.54		20.92		37.61		53.34	
	s	5.67		6.84		1.90		17.38		19.69	
AC	$\bar{x}$	164.67		59.13		21.80		48.70		60.33	
	s	7.35		12.76		4.32		28.89		15.04	
			***p*=0.489 (F=2.42)**		***p*=0.293 (F=3.72)**		***p*=0.493 (F=2.40)**		***p*=0.669 (F=1.56)**		***p*=0.147 (F=5.36)**

* – statistically significant differences at $p < 0.05$ in the Kruskal-Wallis test

legend: BH - biathlon, SS – speed-skating, CCS – cross-country skiing, AC – alpine competitions

Table 3. Comparing the level of strength capacity of female athletes of individual sports

discipline	statistics	sitting from lying position [No.]	*p* *(F)*	hand strength [kg]	*p* *(F)*	overhang with bent arms [s]	*p* *(F)*	pull-ups [No.]	*p* *(F)*
BH	$\bar{x}$	27.95		32.68		27.13		4.22	
	s	3.84		4.12		13.11		9.35	
SS	$\bar{x}$	27.86		34.29		13.30		1.00	
	s	3.25		9.30		7.91		1.41	
CCS	$\bar{x}$	28.72		31.10		27.25		2.10	
	s	3.36		4.43		16.47		3.38	
AC	$\bar{x}$	31.08		30.67		17.96		2.00	
	s	3.06		7.00		13.43		2.00	
			***p*=0.049* (F=7.18)**		***p*=0.599 (F=1.87)**		***p*=0.004* (F=13.59)**		***p*=0.912 (F=0.53)**

* – statistically significant differences at $p < 0.05$ in the Kruskal-Wallis test

legend: BH - biathlon, SS – speed-skating, CCS – cross-country skiing, AC – alpine competitions

hands (dynamometric measurement of hand strength) and the abdominal muscles (sitting from lying position). The results are shown in Table 3.

In terms of the performed strength capacity tests, statistically significant differences between the female, winter sports athletes were found in the strength of the abdominal muscles (sitting from lying position), and functional strength of the arm muscles (overhang with bent arms). When performing sitting from lying position, the highest average number of repetitions was performed by the alpine competition athletes (31.08) and a slightly lower number of repetitions was performed by the cross-country skiers (28.72). The lowest results were obtained by biathlon athletes (27.95) and speed-skaters (27.86). The relative difference between the best and worst result in this case was 10.4%. The post hoc multiple comparison test confirmed a statistically significant advantage of the alpine competition representatives over the biathletes. Compared to other disciplines, the differences were non-significant.

During the overhang with bent arms, by far the best average results were obtained by the female biathletes

(27.13 s) and cross-country skiers (27.25 s). Much worse results were achieved by the alpine competitors (17.96 sec) and speed-skaters (13.30 s). The relative difference between the best and the worst results in this test was as much as 51.2%. The post hoc test confirmed the significant advantage of the skiers and biathletes along with lack of differentiation between them. The results are consistent with the nature of the performed disciplines, whose training regarding the development of the strength of the upper limb girdle undoubtedly more strongly effects the cross-country skiers and female-biathletes in relation to skaters and alpine competitors.

No differences were found between the results obtained by the subjects in strength of the hand muscles or pull-ups.

Comparing the level of speed capacity

In order to determine the examined girls' level of speed capacity, the explosive strength test of the lower limbs was performed (standing long-jump), the speed of locomotion (50-m run) and running, agility tests (shuttle run 4x10-m and envelope run). The results are presented in Table 4.

Table 4. Comparing the level of speed capacity in female athletes of winter sports

discipline	statistics	standing long-jump [cm]	*p* (F)	50-m run [s]	*p* (F)	4x10-m run [s]	*p* (F)	envelope run [s]	*p* (F)
BH	$\bar{x}$	186.68	$p=0.281$ ($F=3.82$)	8.03	$p=0.199$ ($F=4.66$)	11.14	$p=0.921$ ($F=0.49$)	25.95	$p=0.711$ ($F=1.38$)
	s	16.91		0.43		0.50		1.16	
SS	$\bar{x}$	195.79		7.95		11.19		25.52	
	s	15.74		0.32		0.64		1.37	
CCS	$\bar{x}$	187.57		7.91		11.14		26.05	
	s	16.97		0.43		0.58		1.88	
AC	$\bar{x}$	194.33		8.26		11.05		25.56	
	s	13.41		0.48		0.55		1.72	

* – statistically significant differences at $p < 0.05$ in the Kruskal-Wallis test

legend: BH - biathlon, SS – speed-skating, CCS – cross-country skiing, AC – alpine competitions

In the case of all speed capacity tests, there were no statistically significant differences between the female representatives of winter sports. Due to the requirements of the analyzed disciplines, such differences could be expected to benefit alpine competitors and speed-skaters.

Comparing the level of endurance capacity

The level of endurance capacity was assessed in the female athletes based on the following tests: Harvard Step-up Test, 800-meter run and the endurance shuttle run. The results are shown in Table 5.

For all the performed tests, there were no statistically significant differences between the two groups of winter sports players (Tab. 5). In the Harvard Step-Up Test, the best results were achieved by the speed-skaters (80.93) and biathletes (80.40). A slightly lower indicator was represented by the alpine competition athletes (76.08). The worst result was achieved by the cross-country skiers (74.84), with the relative difference of 8.1% compared to the best in this test – the skaters. However, the multiple comparison test did not confirm significant differences between the groups. Interestingly, the difference closest to the adopted significance borderline was found between the cross-country skiers and the related, biathletes ($p = 0.100$).

In the 800-m run, the fasted proved to be the cross-country skiers (176.81 s) and biathletes (179.74 s). The speed-skaters had weaker results (186.51 s), and the slowest were by far, the alpine competition athletes (210.73 s). The relative difference between the best and weakest results was 19.18%. The results of the post hoc test confirmed the greatly weaker results of the alpine competitors than the outcome of the other groups. The skaters also found themselves at the border of the significance threshold in relation to the runners ($p = 0.073$).

The results obtained by the athletes in the shuttle run confirm the observations from the 800-m distance run. With an even level of the endurance-discipline representatives, alpine skiers and snowboarders are much weaker in comparison. The relative difference between the best in this test – the biathletes (9.83) and alpine competitors

Table 5. Comparing the level of endurance capacity in female athletes of winter sports

discipline	statistics	Harvard Step-up Test [index]	*p* (*F*)	800-m run [s]	*p* (*F*)	shuttle run [stage]	*p* (*F*)
BH	$\bar{x}$	80.40	$p=0.034^*$ ($F=8.69$)	179.74	$p=0.000^*$ ($F=22.57$)	9.83	$p=0.008^*$ ($F=11.74$)
	s	10.01		10.74		1.13	
SS	$\bar{x}$	80.93		186.51		9.21	
	s	6.25		12.18		1.25	
CCS	$\bar{x}$	74.84		176.81		9.48	
	s	6.96		9.47		0.89	
AC	$\bar{x}$	76.08		205.27		8.13	
	s	8.55		28.56		1.64	

* – statistically significant differences at $p < 0.05$ in the Kruskal-Wallis test

legend: BH - biathlon, SS – speed-skating, CCS – cross-country skiing, AC – alpine competitions

(8.13), amounted to 11.7%. The multiple comparison test showed no significant differences between the groups of biathletes, runners and skaters. However, they occurred in the alpine – biathlete relation ($p = 0.004$) and the runners ($p = 0.051$).

As expected, the results show a higher level of endurance in athletes of disciplines in which this ability is dominant. It should be noted, however, that the results of the Harvard Step-Up Test are not fully reflected in the results of the locomotive tests.

Comparing the level of coordination capacity

Within the coordination motor ability group, the following were tested: the level of time-spatial orientation based on laboratory measurements using the Piorkowski-type machine and visual-motor tester, reaction time to auditory and visual stimuli (reaction measurement device - RMD) and balance ("Libra" balance platform). The obtained results are shown in Table 6.

Statistically significant differences within the studied coordination capacity between winter sports competitors

Table 6. Comparing the level of coordination abilities in female athletes of winter sports

discipline	statistics	Piorkowski-type machine [No.]	*p* (*F*)	Visual-motor tester [s]	*p* (*F*)	reaction speed to auditory stimulus [s]	*p* (*F*)	reaction speed to visual stimulus [s]	*p* (*F*)	frontal plane balance	*p* (*F*)	sagittal plane balance	*p* (*F*)
BH	$\bar{x}$	68.00	$p=0.615$ ($F=1.80$)	59.29	$p=0.189$ ($F=4.78$)	0.22	$p=0.571$ ($F=2.01$)	0.28	$p=0.079$ ($F=6.79$)	9.75	$p=0.0500^*$ ($F=7.77$)	9.95	$p=0.818$ ($F=0.93$)
	s	28.09		10.19		0.05		0.04		2.94		3.34	
SS	$\bar{x}$	80.46		54.91		0.21		0.25		10.35		10.95	
	s	20.99		5.20		0.03		0.02		3.81		3.78	
CCS	$\bar{x}$	69.21		65.84		0.21		0.26		11.94		11.19	
	s	30.73		16.26		0.06		0.03		3.14		3.07	
AC	$\bar{x}$	73.67		56.73		0.21		0.24		9.40		10.84	
	s	27.70		10.14		0.04		0.03		2.80		1.98	

* – statistically significant differences at $p < 0.05$ in the Kruskal-Wallis test

legend: BH - biathlon, SS – speed -skating, CCS – cross-country skiing, AC – alpinie competitions

were only found in relation to the equivalent test on the balance platform in the frontal plane (Tab. 6). The best result was achieved in the alpine competition athletes (9.40) and biathletes (9.75). The weaker results were represented by the speed-skaters (10.35) and cross-country skiers (11.94). The relative difference between the best and the worst results was 27.02%. Post hoc tests also indicated a weaker result of the runners compared to the 'alpiners' ($p = 0.22$), biathletes ($p = 0.18$) and skaters ($p = 0.28$), but the stated differences proved to be statistically insignificant in the multiple comparisons.

Comparing the measurements of the remaining coordination capacity tests between the studied groups, there were no statistically significant differences.

Discussion

The aim of the study was to compare the level of comprehensive efficiency of young people practicing different winter sports, Zakopane LO ZSMS candidates. The analysis included: somatic build, energy and coordination based motor skills. Selection of the tests characterizing individual motor skills of the competitors was primarily dictated by the MSiT requirements, which imposes performance of the International Physical Fitness Test and Harvard Step-up Test in the context of ZSMS recruitment. The test program was additionally supplemented with trials from the Eurofit test battery and laboratory tests of selected coordination abilities.

Within the somatic measurements, the results did not indicate significant differences in the athletes in terms of their build, however, as expected, the greatest mass and degree of adiposity was characterized by alpine skiers and snowboarders. Downhill skiers usually have well-developed muscles, mostly of the lower limbs and trunk, which affects their mass [16]. Surprising, however, may be the lack of differences in body height. The authors often point to the runners as individuals with a slender physique, slightly taller than the competitors of other ski competitions, and distinguished by longer limbs [19].

The best results in the abdominal muscle strength trial were achieved by the alpine competitors. Due to the nature of these disciplines, these athletes were expected to be superior [14, 20]. Domination of the biathletes and cross-country skiers over other groups in the tests assessing functional strength of the shoulder girdle (overhang with bent arms and pull-ups) was also not surprising. This is understandable because arm strength is important in these disciplines. The poor results of the skaters in the capacity group with the dominant strength ability may be puzzling, however, we should bear in mind that the strength in athletes practicing this discipline is always combined with speed or endurance, and mainly concerns the lower limbs [12, 21].

In analysis of the speed test results, we initially expected variation in favor of the speed-strength disciplines, i.e. the alpine competition, and to a lesser extent, speed-skating (short runs). This was not confirmed by the obtained results, showing no significant differences between disciplines within this capacity.

The level of endurance, especially locomotive, is crucial for athletes of endurance-based (cross-country skiing, biathlon) and endurance-speed (speed-skating) disciplines. The most reliable test in this area is the direct determination of the level of aerobic capacity by setting maximal oxygen uptake (VO_2max) and anaerobic threshold (PPA). Most often, however, VO_2max is estimated using indirect methods with linear dependence between heart rate (HR) and the size of VO_2max with different submaximal loads. The M*argaria*-Kalamen Test or Harvard Step-up Test is used for this purpose. ZSMS Zakopane, as well as other facilities of this type around the country, were obliged by MSiT to use the Harvard Step-up Test. It should be noted here, that the Harvard Step-up Test was developed for the needs of population studies and very often, the results do not confirm accuracy with regard to competitive sports. This is also confirmed by the low correlation coefficient of the results with locomotive endurance tests [22, 23]. This also occurred in the case of the current study, in which the results of the Harvard Step-up test were not confirmed in the motor endurance tests, indicating the cross-country skiers as the weakest group.

In locomotor endurance tests (shuttle and 800-m run), as expected, the best results were achieved by the runners and biathletes, slightly lower by the skaters. Representatives of the alpine disciplines significantly diverged from the other groups

Coordinative motor skills are essential determinants of any form of physical activity, and to a large extent, determine the effectiveness of the actions and behavior of motor units [15]. Feeling and maintaining a given position of the body is the most important goal of any motor action, whether it is performed vertically (as in the case of running or skiing) or horizontally (sledding) [24]. In winter sports, a significant role is played by balance. The technique involving a sliding motion (downhill skiing, cross-country skiing, skating) requires a high level of balance [25]. Analyzing the results of the equivalent tests in the current study, it may be noted that according to the nature of discipline, the highest imbalance was found in the alpine competition athletes because downhill skiing forces a player to maintain stability in very variable conditions, both in the frontal and sagittal planes. Skiing is continuous dynamic balance training. However, the results obtained by the speed-skaters are quite surprising, which contrary to expectations, turned out to be average.

There were, however, no significant differences in the subjects with respect to time-spatial orientation and reaction time. Nonetheless, it should be noted that these attempts were carried out within the so-called "fine motor" skills. Their diagnostic value for the purposes of professional sports has greatly decreased in recent years. This is due to the prevalence of computer games, whose course is very similar to the performed trials, thus, the better results obtained by untrained individuals using the visual-motor tester and the Piorkowski-type machine.

Answering the research question – do the representatives of the individual groups achieve the best results in terms of the motor skills typical for their leading discipline? - it can be stated that in most groups, the results reflect the specifics of the discipline. The leaders of the endurance tests turned out to be the biathletes and cross-country skiers, which is confirmed by the fact that high levels of these capabilities are essential to succeed in these two disciplines. A little surprising may be the results of the 'alpiners', which as expected, do better in coordination tests, but do not stand out from other disciplines regarding speed tests, very characteristic for these disciplines. The skaters ranked at the forefront in the assessment of endurance capacity, but alike the alpine competitors, they did not stand out in the speed tests. During strength tests, they were the weakest of all the studied groups. This was mainly due to the nature of the conducted measurements, assessing this ability in relation to the upper limbs, which is preferred by the runners and biathletes, and does not take into account the fact that the strength of the skaters is mainly developed in the lower limbs.

Conclusions

1. No statistically significant differences in somatic build were found among the female winter sport representatives.
2. As expected, the level of energy-based motor skills differentiates the studied groups of competitors, and the found disparities are the consequence of the disciplines they perform. In the group, the strength capacity of the shoulder girdle was dominated by the runners and biathletes, and the abdomen muscle strength by the alpine competition representatives. There were no significant differences in the level of speed capacity. The results of the locomotive endurance tests indicated superiority of the runners and biathletes.
3. There were no differences between the groups in terms of reaction time and time-spatial orientation. Such differences occurred in the case of balance in the frontal plane, which was dominated by representatives of the alpine competition and biathletes. The average level of this ability in speed-skaters was surprising.

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