BALNEO RESEARCH Balneo and PRM Research Journal
English Edition
e ISSN 2734 - 8458 p ISSN 2734 - 844X ROMANIAN ASSOCIATION OF BALNEOLOGY
ARB Asociatia Romana de Balneologie

Research article

The influence of the specificity of sports specializations on the values of muscle power for female university students

George Danut Mocanu [1*], Gabriel Murariu [2*]

1. "Dunărea de Jos" University, Faculty of Physical Education and Sports, 63-65 Gării Street, Galați, România, george.mocanu@ugal.ro
2. "Dunarea de Jos" University of Galati, Faculty of Sciences and Environment, 47 Domneasca Street, 800008 Galati, Romania

* Correspondence: G.D.M. george.mocanu@ugal.ro , G.M. Gabriel.murariu@ugal.ro

Citation: Mocanu G.D., Murariu G. – The influence of the specificity of sports specializations on the values of muscle power for female university students
Balneo and PRM Research Journal **2023**, *14(2): 563*

Academic Editor(s):
Constantin Munteanu

Reviewer Officer:
Viorela Bembea

Production Officer:
Camil Filimon

Received: 25.05.2023
Accepted: 15.06.2023
Published: 23.06.2023

Reviewers:
Mariana Rotariu
Ilie Onu

Abstract ***Background:*** Explosive strength or muscle power plays a decisive role in the motor performance of all athletes. ***Purpose:*** Analysis of muscle strength variations for female students of the Faculty of Physical Education and Sport/undergraduate level, according to sports specializations. ***Material and method***: The study included 77 women (age = 20.48 ± 1.37 years, weight = 58.79 ± 8.92 kg, height = 166.24 ± 7.13 cm), divided into 3 evaluation subgroups (Non-athletes/NA = 40 cases, Team sports games/TSG = 17 cases and IS/Individual sports = 20 cases). Explosive strength rating was based on 7 lower body tests and 6 upper body tests. Manova parametric techniques were applied. ***Results***: The analysis of variance indicates significant differences between the 3 defined groups, the F values correspond to thresholds $p < 0.05$. Pairwise analysis highlights the statistical superiority of TSG and IS groups compared to NA. We noted better values of the TSG group of women in all upper body strength assessment tests, but these differences are not significant ($p > 0.05$). Top performance values are dominated by sprinters and volleyball players for the lower body, respectively by handball, volleyball and karate players for the upper body, as-pects confirmed by the studied sources. ***Conclusion***: We did not identify significant differences between the groups of athletes (TSG and IS), and the top values according to sports specialization reinforce the results of other similar studies, the specific effort obviously infusing the performance in the muscle strength tests.

Keywords: specific effort, muscle power, rapid contractions, adaptation, university students

1. Introduction

Muscular strength (FxV) involves the ability to perform explosive movements, being decisive in increasing sports results in team sports as well as in individual ones. Explosive movements in team sports, track and field or combat sports require high levels of muscle power [1–10]. Physical activities (leisure and performance) have a role in the development of effort capacity and quality of life [11–20].

The use of Squat Jump Training, with reduced volumes of work for sedentary youth (21.5 years) generated an increase in the power of performance in jumps, as an effect of muscle coordination and neural adaptations [21]. The superior physical performances of athletes and those who are physically active are explained by the beneficial effects of physical exercises (improving musculo-skeletal, cardiovascular and anti-inflammatory functions), even if there are also studies that signal the negative impact of physical demands, associated with oxidative stress [22,23].

The effect of dehydration on muscle power is different, depending on the tests applied: studies on athletes (20-23 years old) indicate that there are no significant decreases in vertical jump performance and maximal isometric force, but the result in 10m acceleration is negatively influenced by dehydration [24]. The strength deficits at thigh and hip level increase injury risk and limits the functional performance during jumping in studies of recreational athletes of both sexes [25].

Performances in jumping variants and body stability tests are influenced by the manifestation of muscle fatigue, the rates/level of fatigue being different depending on the leg (dominant vs non-dominant), fatigue increases the bilateral asymmetry in jumping performances [26]. Interlimb asymmetry in soccer players (Premier League U23, U19 and U16) is associated with lower physical performance in lower limb power tests (short distance sprint and vertical jump) in all age groups [27]. This aspect is also confirmed for young female soccer players, where poorer sprint times are negatively associated with vertical asymmetries in the CMJ test [28]. The presence of large asymmetries for Spanish handball and basketball players (18.98 years) could negatively influence the results of the vertical and horizontal jump tests. [29].

Increases in Fat Mass are negatively associated with the performance of young Croatian adolescent girls in the Standing Long Jump test, and for those in the Fat Free Mass category, positive associations are obtained [30]. The use of acupuncture on a group of physically active Chinese university students (23.8 years old) generated an improvement in joint stiffness and improvement in the level of explosive force at the level of the knee joint [31]. Strong and significant associations between core stability and upper body strength test performance assessed by medicine ball chest throw are identified for Saudi Arabian student athletes [32]. Studies based on meta-analysis establish the effects of practicing the martial art of Taekwondo on fitness values, including lower body muscle strength. If for the Standing Long Jump the effects are moderate, for the Vertical jump test very strong effects are identified, possibly as a result of the vertical jumps from the fighting technique [33]. Explosive leg and arm strength is also important in badminton, ensuring quick movements and higher hitting speed [34].

A study on female handball players in the first Spanish league confirms anthropometric differences (at the level of the upper body) and superiority in ball throwing speed for top elite players compared to elite level players [35]. Muscle strength values in jump tests increase with training accumulations and body maturation. The comparison between young (16 years old) and experienced (24.8 years old) female volleyball players shows higher values for the latter in lower limb strength tests, according to [36]. For young Croatian female volleyball players, no variations in physical performance are reported according to playing positions, but there are major differences in upper and lower body muscle strength tests between successful players and those with poor sports performance [37]. Analysis by age, gender, playing position and competitive level of vertical jump (CMJ) performance for soccer players provides interesting information. No significant differences are identified between the positions on the field, although Fullbacks have the best values, followed by Midfielders, Central Def., Goalkeepers and Strikers. The U19 women have lower scores than the seniors, an aspect also confirmed in the case of the men. Players in the national league have superior explosive strength to those in the regional or local leagues, at all age groups, so the higher competitive level also requires a higher level of fitness [38]. High-performing female sprinters from Serbia (as opposed to younger ones) have a higher capacity to transform explosive strength per unit of time, as well as better concentric phase velocity for vertical jumps, which are correlated with performance in sprint tests. [39].

Research on Spanish students has identified better physical and academic performance for those who use less the mobile phone (and presumably spend more time on physical activities), with boys performing better than girls. This batch achieves superior results in standing long jump/SLJ and Overhead Medicine Ball Throw (forwards) [40]. Specific training in volleyball and basketball (for 3 years) ensures neuromuscular adaptations and improved muscle strength values for female athletes, compared to non-athletic groups. Better performances in vertical jump and medicine ball throw/3kg are identified, and volleyball female players have higher values than basketball female players in vertical jump, according to [41].

A comparative analysis between anthropometric characteristics and motor skills of female volleyball players (19.57 years old) and basketball players (21.92 years old) from Turkey identified higher height and body weight values for basketball players, and in the

10m acceleration test, volleyball female players have significantly better results [42]. The specifics of the practiced sport decisively influence the value of performance in power tests. Poorer performance of US college basketball players (20 years old) compared to soccer players (19.2 years old) for frontal jumps (medial and lateral triple hop tests) is identified [43]. Studies of sprinters and high jumpers (elite level) report no significant differences between these categories in vertical jump value, even though sprinters have a slightly better average score. Differences between the sexes of approximately 10 cm are identified, in favor of men [44]. A comparison of lower body muscle strength values between young girls practicing athletics and aerobic gymnastics revealed the (non-significant) superiority of female athletes for countermovement jump/CMJ and Squat jump, and female gymnasts have a better score for repeated vertical jumps [45]. The comparison of muscular strength and speed performances between athletic (soccer, netball, badminton and athletic) and non-athletic (21.18 years old) female university students in Ghana indicates significantly better performance of female athletes for speed and shoulder and arm strength, but not for leg strength, where soccer, athletics and badminton players have superior performances compared to netball [46]. The type of martial arts practiced influences the vertical jump values. The comparison between Indian female judoka and Wushu athletes indicates a significant superiority for the female judoka group [47].

The purpose of the research: Our investigation aimed to identify the differences that occur between female university students in the Faculty of Physical Education and Sport, for upper and lower body explosive power, by comparing the results of the Non-athletes/NA, Team sports games/TSG and Individual sports/IS groups.

2. Materials and Methods

2.1. Participants

77 female university students/undergraduate students from the Faculty of Physical Education and Sport in Galati (age = 20.48 ± 1.37 years, weight = 58.79 ± 8.92 kg, height = 166.24 ± 7.13 cm) were involved in the study. The batch was divided into 3 distinct categories: Non-athletes/NA (40 cases), Team sports games/TSG (basketball 3, handball 7, volleyball 6, hockey 1) and Individual sports/IS (track and field 5, cycling 1, sports dance 3, fitness 8, karate 1, swimming 1, tennis 1). The number of subjects and percentages for each category are summarized in Table 1. The research was scheduled in the last month of teaching activity (May) of the 2nd semester of 2019. All subjects were instructed about the purpose of the study, and the conditions for applying the evaluation tests. Data confidentiality requirements for research involving human subjects were followed with [48,49].

Table 1. Division of the batch by sports specializations

Gender	Participants	Non-athletes	Team sports games	Individual sports
Female	77 (100%)	40 (51.94%).	17 (22.08%)	20 (25.98%)

2.2. The organization of the research

The testing of the student group was carried out in the Research Center for Human Performance, affiliated to the Faculty of Physical Education and Sport in Galati. Explosive strength of the upper and lower body was evaluated by the following 13 field tests: (Shot put/track and field, Medicine ball chest throw, Overhead Medicine Ball Throw-forward, Overhead Medicine Ball Throw, 30s Plyometric Push-Ups, Shot Overhand ball throw, SLJ/Standing Long Jump Test, VJT/Vertical Jump Test, 3-Hop Test, 30s Lateral double leg hop, 30s Continuous vertical jumps, The multiple 5 bounds test, Speed Test 10m), according to information provided by [50].

2.3. The statistical analysis of data

The SPSS software (Statistical Package for the Social Sciences/IBM Vers.24 Chicago, IL, USA). was used to calculate the research results. The normality distribution curve of the data was checked for each test at the level of the investigated groups. The parametric MANOVA techniques (multivariate and univariate tests) were applied, the highlighting of F values and significance thresholds for the differences between the averages of the analyzed pairs (with the use of Bonferroni Post Hoc Tests), the size effect/Ƞ2p calculation, Levene's Test of Equality of Error Variances. The confidence interval was set at 95% ($p < 0.05$) [51–56].

3. Results

Tables 2-8 present by sections the main values of the research for the group of university students tested.

Table 2. The results of the Multivariate Tests (MANOVA[a]).

Gender	Effect	λ	F	Hypothesis df	Error df	Sig.	η^2_p	Observed Power
Female	Sport activity	0.289	4.106[b]	26.000	124.000	0.000	0.463	1.000

a. Design: Sport activity
b. Exact statistic
λ-Wilk's lambda; F-Fisher test; df-degrees of freedom; Sig.-level of probability; η^2_p-partial eta squared

The multivariate analysis (Multivariate Tests) indicates statistically significant influences ($p < 0.05$), with very strong values of the size effect/Ƞ2p (46.3% of the variance of the strength test results is explained by the Sport activity variable for women).

Table 3. Univariate test results (ANOVA) – The influence of the Sport activity variable on the results of the lower body strength. tests.

Dependent Variable	Sum of Squares	Mean Square	F_f (2, 144)	Sig.	Partial Eta Squared	Observed Power
Vertical Jump Test/VJT	979.529	489.765	35.929	0.000	0.493	1.000
Standing Long Jump Test/SLJ	12301.282	6150.641	25.555	0.000	0.409	1.000
3-Hop Test	102220.739	51110.369	22.437	0.000	0.377	1.000
The multiple 5 bounds test/MB5	182063.363	91031.682	15.231	0.000	0.292	0.999
30s lateral double leg hop test	1561.869	780.935	13.771	0.000	0.271	0.998
Speed Test 10m	0.312	0.126	21.780	0.000	0.371	1.000
30s Continuous vertical jumps	241.148	120.574	7.443	0.001	0.167	0.933

F_f (F-Fisher test female)

For most lower body strength tests we report statistically significant differences through univariate test results. Partial Eta Squared values signal very strong effects only in women (eg 49.3% of performance variance in vertical jump height, 41.5% of variance in LFE, 37.7% of variance in 3 jumps etc.) are explained by the Sporting Activity variable**.**

Table 4. Univariate test results (ANOVA) – The influence/effect of the variable Sport activity on the results of strength tests at the level of the upper body.

Dependent Variable	Sum of Squares	Mean Square	F_f (2, 144)	Sig.	Partial Eta Squared	Observed Power
Overhand ball throw (OBT)	925.991	462.995	24.643	0.000	0.400	1.000
Shot put -track and field	153609.941	76804.971	9.965	0.000	0.212	0.981
Overhead Medicine Ball Throw-forward 3kg	172467.603	86233.802	9.268	0.000	0.200	0.973
Overhead Medicine Ball Throw-backward 3kg	273584.428	136792.214	13.150	0.000	0.262	0.997
Medicine ball chest throw 3kg	96495.494	48247.747	8.881	0.000	0.194	0.967
30s Plyometric Push-Ups/clap push ups	136.237	68.118	5.161	0.008	0.122	0.812

F_f (F-Fisher test female)

Univariate test at the level of the upper body, indicates significant influences of the independent variable Sport activity on the level of strength results (P<0.05). The Partial Eta Squared values indicate very strong effects of the Sport activity variable on performances for women (40% of the variance in Overhand ball throw, 21.2% of the variance in weight throw or 26.2% of the variance in Throwing the medicine ball back over the head are explained by the Sport activity variable). The only value that indicates medium effects for the women's group is for the 30 s push-ups pliometric test (where only 12.2% of the variance is due to the independent variable).

Table 5. Analysis of the significance of differences between average scores by categories of sports activities in strength tests for the lower body / female (NA=40, TSG=17, IS=20).

Test	Group	Mean	Std. deviation	Std. error	a-b	Sig.[b]	a-c	Sig.[b]	b-c	Sig.[b]
Vertical Jump Test/VJT	a. NA	28.565	3.487	0.584	-6.847*	0.000	-7.370*	0.000	-0.523	1.000
	b. TSG	35.411	4.327	0.895						
	c. IS	35.935	3.514	0.826						
Standing Long Jump Test/SLJ	a. NA	164.325	14.422	2.453	-19.734*	0.000	-28.625*	0.000	-8.891	0.259
	b. TSG	183.647	16.998	3.763						
	c. IS	192.950	16.343	3.469						
3-Hop Test	a. NA	502.250	49.046	7.546	-53.691*	0.001	-83.700*	0.000	-30.009	0.182
	b. TSG	555.941	41.882	11.576						
	c. IS	585.950	49.569	10.672						
The multiple 5 bounds test/MB5	a. NA	833.500	72.657	12.224	-70.618*	0.007	-112.050*	0.000	-41.432	0.326
	b. TSG	904.117	74.746	18.750						
	c. IS	945.550	87.959	17.287						
30s lateral double leg hop test	a. NA	18.575	6.151	1.191	-6.837*	0.007	-10.275*	0.000	-3.438	0.512
	b. TSG	25.411	9.585	1.826						
	c. IS	28.850	8.112	1.684						
Speed Test 10m	a. NA	2.154	0.074	0.013	0.123*	0.000	.131*	0.000	0.008	1.000
	b. TSG	2.031	0.094	0.021						
	c. IS	2.023	0.095	0.019						
30s Continuous vertical jumps	a. NA	17.500	3.802	0.636	-2.500	0.106	-4.100*	0.001	-1.600	0.696
	b. TSG	20.000	4.000	0.976						
	c. IS	21.600	4.465	0.900						

*The mean difference is significant at the .05 level.

[b]Adjustment for multiple comparisons: Bonferroni.

For the lower body it should be noted that the best results are obtained by the IS group, at the level of the entire set of applied tests, but the differences compared to the TSG group are not significant (P>0.05). The small number of participants in these two groups does not allow us to generalize this finding, especially since the IS group includes several performance athletes (speed runners), who definitely improve the average value of this group. The differences between the 2 groups of athletes and the NA group are statistical-ly significant (P<0.05), with only one exception, also for Vertical jumps with object touch – 30s, between the TSG and NA groups.

Table 6 - Analysis of the significance of differences between average scores by categories of sports activities in strength tests for the upper body / female (NA=40, SG=17, IS=20).

Test	Group	Mean	Std. deviation	Std. error	a-b	Sig.ᵇ	a-c	Sig.ᵇ	b-c	Sig.ᵇ
Overhand ball throw (OBT)	a. NA	22.470	3.495	0.685						
	b. TSG	30.705	5.708	1.051	-8.236*	0.000	-5.265*	0.000	2.971	0.124
	c. IS	27.735	4.545	0.969						
Shot put -track and field	a. NA	467.625	69.846	13.881						
	b. TSG	567.176	114.875	21.293	-99.551*	0.001	-78.575*	0.005	20.976	1.000
	c. IS	546.200	94.299	19.631						
Overhead Medicine Ball Throw-forward 3kg	a. NA	507.175	64.503	15.251						
	b. TSG	613.235	144.547	23.395	-106.060*	0.001	-82.475*	0.008	23.585	1.000
	c. IS	589.650	100.510	21.569						
Overhead Medicine Ball Throw-backward 3kg	a. NA	581.950	92.831	16.126						
	b. TSG	720.294	113.761	24.736	-138.344*	0.000	-96.550*	0.003	41.794	0.654
	c. IS	678.500	109.208	22.806						
Medicine ball chest throw 3kg	a. NA	476.125	39.353	11.654						
	b. TSG	549.647	71.924	17.876	-73.522*	0.003	-68.425*	0.003	5.097	1.000
	c. IS	544.550	116.717	16.481						
30s Plyometric Push-Ups/clap push ups	a. NA	1.300	2.472	0.574						
	b. TSG	4.176	4.811	0.881	-2.876*	0.023	-2.450*	0.048	0.426	1.000
	c. IS	3.750	4.399	0.812						

*The mean difference is significant at the .05 level.
ᵇAdjustment for multiple comparisons: Bonferroni.

The results of the women in the upper body strength evaluation tests indicate significant differences between the female athletes' groups and the NA group for all 6 tests (P<0.05), and between the TSG and IS groups we have neither at least a significant difference (P>0.05). However, we note the superiority of the averages of TSG female students compared to IS female students in all tests, so the strength demands related to throws in sports games are confirmed only for girls, by better results, but it must be taken into account that female soccer players do not exist in this group. The most difficult test in this set is definitely the 30 s plyometric push-ups, in which 35 female students (25 from the NA group, 6 from the IS group and 4 from the TSG group) get a score of 0, so they cannot perform even one push-up.

Table 7: The values of the best 3 individual results for each strength test at the lower body level (female/according to the practiced sport).

Test	Gender	Performance 1 (sport)	Performance 2 (sport)	Performance 3 (sport)
Vertical Jump Test/VJT	**F**	45.5 (fitness)	44 (volleyball)	42 (volleyball)
Standing Long Jump Test/SLJ	**F**	238 (Track and field)	231 (volleyball)	221 (cycling)
3-Hop Test	**F**	722 (Track and field)	651(volleyball)	641 (cycling)
The multiple 5 bounds test/MB5	**F**	1233 (Track and field)	1027 (volleyball)	1025 (cycling)
30s lateral double leg hop test	**F**	49 (volleyball)	47 (fitness)	46 (non-athletes)
Speed Test 10m	**F**	1.76 (Track and field)	1.86 (volleyball)	1.89 (handball)
30s Continuous vertical jumps	**F**	29 (karate)	28 (fitness)	28 (handball)

The superiority of volleyball players and sprinters for most lower body strength tests is evident (table 7). With one exception for girls (Vertical jump with object touch - 30s), those specializing in combat sports are not found in this ranking. Also among girls we identify the only case of superior performance of those from the NA group, for Lateral Jumps - 30 s.

Table 8: The values of the best 3 individual results for each strength test at the upper body level (female/according to the practiced sport).

Test	Gender	Performance 1 (sport)	Performance 2 (sport)	Performance 3 (sport)
Overhand ball throw (OBT)	**F**	38.9 (handball)	38.1 (handball)	37 (handball)
Shot put -track and field	**F**	795 (karate)	778 (volleyball)	752 (handball)
Overhead Medicine Ball Throw-forward 3kg	**F**	964 (handball)	891 (volleyball)	809 (karate)
Overhead Medicine Ball Throw-backward 3kg	**F**	984 (volleyball)	916 (karate)	912 (Track and field)
Medicine ball chest throw 3kg	**F**	986 (karate)	688 (handball)	667 (volleyball)
30s Plyometric Push-Ups/clap push ups	**F**	18 (karate)	16 (volleyball)	15 (handball)

The top is dominated by handball and volleyball players, as a result of the strong specific demands in training (table 8). The fact that handball female players occupy the first 3 positions in overhead ball throwing can be explained by the structural similarity of the test with the throwing technique in handball (throwing type). Some superior results of karate practitioners are also observed, which are well represented in this top.

4. Discussion

The results of our study were compared to the values of other similar scientific works. Research in soccer players (both genders in NCAA Division II, age 18-23 years old) reported moderate to strong associations between vertical jump and sprint speed. For the 10m sprint women have a value of 1.92s, according to [57]. For female handball players from Turkey (national team) aged 22.8 years, an average value of 1.84s is recorded in the 10m acceleration test [58]. 10m acceleration capability for Turkish soccer players (21.09 years and 10.59 years training experience) shows a very good average value of 1.68s [59]. At the level of the Juniors group (age 21.6 years and 4 years of experience) for female soccer players (division 1 collegiate in the USA) the following results are obtained: 51cm for vertical jump test (VJT), 206 cm for standing long jump (SLJ), respectively 1.958s for 10m speed test [60]. Comparison of explosive strength performance of Indian college female basketball and volleyball players (18-28 years) indicates superiority (statistically insignificant) of basketball players for most tests based on jumps, medicine ball throws and cricket ball throw. At VJT, the volleyball players get 41.53cm, and the basketball players get 39.8cm [61]. All these results shown are more valuable than those obtained by our TSG groups.

The use of Single-Leg Speed Hop Exercise in the training programs of Indonesian athletes (specialized in aerobic gymnastics) favors improvements in muscle strength indicators at the level of the lower body. For men, final average values of 232.5cm are obtained at SLJ (close to those of our batches), and for women of 161.25cm (weaker than all the women's batches analyzed by us) [62].

A study on American female athletes (22.67 years old) practicing team sport games (softball, netball, soccer and basketball) identifies values of 1.98s for the 10m acceleration test, 43.44cm for the VJT and 179cm for the SLJ, according to [63]. By comparison, only at SLJ does our TSG women's batch outperform. The superiority of men over women in the 10m sprint test is obvious, for male athletes the best average is achieved by basketball players (1.84s), followed by cricket (1.85s) and soccer (1.93s). For women, netball players have the best average (1.96s), followed by cricket (2.05s) and soccer (2.14s) [64]. Our TSG (female) group performs better in the 10m sprint compared to soccer female players, but less compared to netball.

The effect of different types of warm ups (light jogging vs static stretching, medicine ball and mini-band) for female college soccer players from the USA (19.3 years old) does not show significant differences between the variants listed for muscle strength tests, but the best results are obtained by the light jogging variant: 34cm for VJT, 2.04s for 10m sprint [65]. Our group of TSG girls has average scores similar to those of the analyzed study. Strength training with moderate loads is significantly correlated with Croatian youth soccer players' Standing Long Jump performance, so using these loads facilitates jumping performance. Average values of 225.15cm are obtained at SLJ [66]. The values are similar to our group of male soccer players. The comparison of leg muscle strength test performance between soccer and basketball players by age group provides interesting results that indicate the superiority of soccer players. Speed Test 10m indicates better values of soccer players compared to basketball players in U18 (1.75s vs 1.81s) and Adults (1.73s vs 1.84s) [67]. Our soccer group, however, performs worse compared to the presented results, but also compared to the average of the other investigated sports games.

Gender differences regarding anthropometric characteristics and fitness level of Polish university students (20 years old) identify higher values in men, except in flexibility tests. Even though body mass and BMI values are negatively correlated with almost all tests, positive associations are reported for throwing the medicine ball over the head (back and forth). The upper limits are for women in the Medicine ball backward throw of 1250cm and for men of 1745cm, and in the Medicine ball forward throw they are 1075 and 1283cm [68]. Our study indicates similar extreme values for men in medicine ball backward throw, but lower for women. In the medicine ball forward throw we obtained better extreme values only for men. For US female college soccer players (19.3 years) values of 712cm are obtained for 4kg Overhead Medicine Ball Throw (behind) [65]. Surprisingly, this score is superior to the group of TSG female practitioners we investigated, even when a heavier medicine ball is used.

The competitive sports performance of young Hungarian tennis players (U18) is significantly associated with the value of overhead medicine ball throw test (1kg) and overhand ball throw /OBT only in the case of women. For the overhead medicine ball throw test they achieve a performance of 1074cm, and the men 1450cm. In overhand ball throw/OBT (103g) women achieve 30.65m and men 48.23m [69]. Comparison with our results is not relevant due to the low weight of the thrown objects, even though the performances are similar for women.

For female basketball players in the UK National League, Playing Position influences strength test results. In Medicine ball chest throw, the best value is for Centers, with 717 cm, followed by Forwards with 689 cm and Guards with 671 cm [70]. Centers' results are similar to those of the TSG women investigated by us (720cm), for the other positions they are weaker.

5. Conclusions

The statistical processing of the results (univariate tests) highlighted statistically significant differences induced by the type of sports activity for all explosive force assessment tests. However, pairwise analysis of the data indicates that no statistically significant differences are reported between the TSG and IS groups, being observed only between the IS and NA groups, and TSG and NA, respectively. However, we note the better performance values for upper body strength at the TSG level (as a result of constant demands and adaptation of these muscle groups), but without significant differences ($p>0.05$). Top performance values are dominated by sprinters and volleyball players for the lower body, respectively by handball, volleyball and karate players for the upper body, aspects confirmed by the studied sources.

The limits of the study are generated by the imbalance between the sports specializations of the female students and the small number of participants, these results being only a characteristic of the groups studied and cannot be generalized.

Author Contributions: "Conceptualization, G.D.M.; methodology, G.D.M.; software, G.D.M. and G.M.; validation, G.D.M and G.M.; formal analysis, G.D.M..; investigation, G.D.M.; resources, G.D.M.; data curation, G.D.M and G.M..; writing—original draft preparation, G.D.M.; writing—review and editing, G.D.M and G.M.; visualization, G.D.M.; supervision, G.D.M and G.M..; project administration, G.D.M and G.M.; funding acquisition, G.M. The authors have read and agreed to the published version of the manuscript."

Funding: "This research received no external funding"

Institutional Review Board Statement: "The study was conducted according to the guidelines of the Declaration of Helsinki, and ap-proved by the Institutional Review Board (or Ethics Committee) of "Dunarea de Jos" University of Galati.".

Informed Consent Statement: All investigated students agreed to participate in the study.

Acknowledgments: The authors thank the students of the Faculty of Physical Education and Sports from Galati for participating in this study

Conflicts of Interest: "The author declares no conflict of interest."

References

1. Parvu, C. *Metodica Predării Voleiului În Gimnaziu Și Liceu*; Universitaria: Craiova, 2017; ISBN 978-606-14-1146-7.
2. Harabagiu, N.; Pârvu, C. The Statistical Analysis of the Game Actions of the Middle-Blocker Based on the Application of the "Data Volley" Software. *Revista Romaneasca pentru Educatie Multidimensionala* **2022**, *14*, 101–110, doi:10.18662/rrem/14.1Sup1/539.
3. Pătrăucean, P.; Vizitiu, E. Study on the Development of the Motor Quality Force by Using the Isometric Contraction Process. *SAM* **2022**, *15*, 135, doi:10.4316/SAM.2022.0217.
4. Gani, R.A.; Achmad, I.Z.; Julianti, R.R.; Setiawan, E.; Németh, Z.; Muzakki, A.; Yanti, N.; Habibie, H. Does the Athletes' Leg Muscle Power Increase After the Tabata Aquatic Program? *Physical Education Theory and Methodology* **2022**, *22*, 56–61.
5. Joksĭmovĭc, M.; Németh, Z.; Skrypchenko, İ.; Trĭvun, M.; Pantovĭć, M. Gender differences in development of explosive power and rapidity in schoolchildren aged 14-15 years old. *JIASSCIENCE* **2018**, *3*, 294–304.
6. SINGH, V.; Acharya, J.; Bhutia, T.N. Effect of 6 Weeks of Online Vinyasa Training on Explosive Leg Strength of School Children during COVID-19 – A Pilot Study. *JPES* **2021**, *21*, 7, doi:10.7752/jpes.2021.s4304.
7. Z.B.Khamraeva Planning Annual Training for Runners Running Over Obstacles. *Eurasian Scientific Herald* **2022**, *8*, 229–232.
8. Khamraeva, Z.B. Application of Multi-Year Training Works in Training Athletics in Training Cycles. *Open Access* **2022**, *3*.
9. Iermakov, S.; Yermakova, T.; Wnorowski, K.; Bensbaa, A. Beach Volleyball Athlete Training Trends of Russian-Language Scientific Resources: A Systematic Review. *Physical Education of Students* **2021**, *25*, 319–338, doi:10.15561/20755279.2021.0508.
10. Podrigalo, L.; Romanenko, V.; Podrihalo, O.; Iermakov, S.; Huba, A.; Perevoznyk, V.; Podavalenko, O. Comparative Analysis of Psychophysiological Features of Taekwondo Athletes of Different Age Groups. *Pedagogy of Physical Culture and Sports* **2023**, *27*, 38–44, doi:10.15561/26649837.2023.0105.
11. Postelnicu, M.G.; Gheorghe, C. Identification the level of development of motor indices at the level of juniors female handball teams. *Annals of "Dunarea de Jos" University of Galati. Fascicle XV, Physical Education and Sport Management* **2022**, *1*, 79–85, doi:10.35219/efms.2022.1.06.
12. Vizitiu, E.; Constantinescu, M. Chapter 27 - Impact of Physical Activities on Overweight People during the COVID-19 Pandemic. In *Biomedical Engineering Applications for People with Disabilities and the Elderly in the COVID-19 Pandemic and Beyond*; Balas, V.E., Geman, O., Eds.; Academic Press, 2022; pp. 313–324 ISBN 978-0-323-85174-9.
13. Chen, L. Impacts of Aerobics and Cheerleading on High School Students. *Rev. bras. med. esporte* **2023**, e2022_0465-e2022_0465.
14. Folostina, R.; Iacob, C.I.; Syriopoulou-Delli, C.K. Physical Activity, Sedentary Behaviour and Quality of Life in Children with Autism: Insights from Romania and Greece. *International Journal of Developmental Disabilities* **2023**, *69*, 432–441, doi:10.1080/20473869.2023.2204574.

15. Silişteanu, S.-C.; Covaşă, M. The Importance of Nutrition and Physical Activity in Young People Increased Quality of Life. In Proceedings of the 2015 E-Health and Bioengineering Conference (EHB); IEEE, 2015; pp. 1–4.
16. Wang, M.-H. Influence of sport dance courses on female college students. *Rev Bras Med Esporte* **2023**, *29*, e2022_0783, doi:10.1590/1517-8692202329012022_0783.
17. Liu, B.; Yi, Y. Effects of functional training on the hitting quality of tennis players. *Rev Bras Med Esporte* **2023**, *29*, e2022_0620, doi:10.1590/1517-8692202329012022_0620.
18. Munteanu, C.; Munteanu, D. Thalassotherapy Today. *BALNEO* **2019**, *10*, 440–444, doi:10.12680/balneo.2019.278.
19. Ciorap, R.; Andriţoi, D.; Casuţă, A.; Ciorap, M.; Munteanu, D. Game-Based Virtual Reality Solution for Post-Stroke Balance Rehabilitation. *IOP Conf. Ser.: Mater. Sci. Eng.* **2022**, *1254*, 012037, doi:10.1088/1757-899X/1254/1/012037.
20. Luca, C.; Fuior, R.; Corciovă, C.; Andriţoi, D. Development of an Interactive Post-Stroke Rehabilitation Tool Based on Microsoft Kinect. In Proceedings of the 2019 E-Health and Bioengineering Conference (EHB); November 2019; pp. 1–4.
21. Isaacs, A.W.; Myburgh, K.H.; Macaluso, F. Low-Volume Squat Jump Training Improves Functional Performance Independent of Myofibre Changes in Inactive Young Male Individuals. *Healthcare* **2022**, *10*, 1217, doi:10.3390/healthcare10071217.
22. Daniela, M.; Catalina, L.; Ilie, O.; Paula, M.; Daniel-Andrei, I.; Ioana, B. Effects of Exercise Training on the Autonomic Nervous System with a Focus on Anti-Inflammatory and Antioxidants Effects. *Antioxidants* **2022**, *11*, 350, doi:10.3390/antiox11020350.
23. Matei, D.; Buculei, I.; Luca, C.; Corciova, C.-P.; Andritoi, D.; Fuior, R.; Iordan, D.-A.; Onu, I. Impact of Non-Pharmacological Interventions on the Mechanisms of Atherosclerosis. *International Journal of Molecular Sciences* **2022**, *23*, 9097, doi:10.3390/ijms23169097.
24. Harcourt, B.A.; Panagiotopoulos, M.; Sardelis, S.; Terzis, G.; Bogdanis, G.C. The Effect of Dehydration on Vertical Jump, Muscle Strength and Sprint Performance. *Proceedings* **2019**, *25*, 10, doi:10.3390/proceedings2019025010.
25. Kollock, R.; Van Lunen, B.L.; Ringleb, S.I.; Oñate, J.A. Measures of Functional Performance and Their Association With Hip and Thigh Strength. *Journal of Athletic Training* **2015**, *50*, 14–22, doi:10.4085/1062-6050-49.3.49.
26. Guan, Y.; Bredin, S.; Jiang, Q.; Taunton, J.; Li, Y.; Wu, N.; Wu, L.; Warburton, D. The Effect of Fatigue on Asymmetry between Lower Limbs in Functional Performances in Elite Child Taekwondo Athletes. *J Orthop Surg Res* **2021**, *16*, 33, doi:10.1186/s13018-020-02175-7.
27. Bishop, C.; Brashill, C.; Abbott, W.; Read, P.; Lake, J.; Turner, A. Jumping Asymmetries Are Associated With Speed, Change of Direction Speed, and Jump Performance in Elite Academy Soccer Players. *The Journal of Strength & Conditioning Research* **2021**, *35*, 1841–1847, doi:10.1519/JSC.0000000000003058.
28. Bishop, C.; Read, P.; McCubbine, J.; Turner, A. Vertical and Horizontal Asymmetries Are Related to Slower Sprinting and Jump Performance in Elite Youth Female Soccer Players. *The Journal of Strength & Conditioning Research* **2021**, *35*, 56–63, doi:10.1519/JSC.0000000000002544.
29. Barrera-Domínguez, F.J.; Carmona-Gómez, A.; Tornero-Quiñones, I.; Sáez-Padilla, J.; Sierra-Robles, Á.; Molina-López, J. Influence of Dynamic Balance on Jumping-Based Asymmetries in Team Sport: A between-Sports Comparison in Basketball and Handball Athletes. *International Journal of Environmental Research and Public Health* **2021**, *18*, 1866, doi:10.3390/ijerph18041866.
30. Kasović, M.; Oreški, A.; Vespalec, T.; Gimunová, M.; Štefan, L. Associations between Fat Mass and Fat Free Mass with Physical Fitness in Adolescent Girls: A 3-Year Longitudinal Study. *Biology* **2022**, *11*, 783, doi:10.3390/biology11050783.
31. Wang, J.; Wang, I.-L.; Hu, R.; Yao, S.; Su, Y.; Zhou, S.; Chen, C.-H. Immediate Effects of Acupuncture on Explosive Force Production and Stiffness in Male Knee Joint. *International Journal of Environmental Research and Public Health* **2021**, *18*, 9518, doi:10.3390/ijerph18189518.
32. Nuhmani, S. Correlation between Core Stability and Upper-Extremity Performance in Male Collegiate Athletes. *Medicina* **2022**, *58*, 982, doi:10.3390/medicina58080982.
33. Nam, S.-S.; Lim, K. Effects of Taekwondo Training on Physical Fitness Factors in Korean Elementary Students: A Systematic Review and Meta-Analysis. *J Exerc Nutrition Biochem* **2019**, *23*, 36–47, doi:10.20463/jenb.2019.0006.
34. Asif, M.; Zutshi, K.; Munjal, J.; Dhingra, M. Relationship among height, explosive power and shoulder strength on smashing accuracy in male badminton players. *European Journal of Physical Education and Sport Science* **2018**, *4*, 15, doi:10.46827/ejpe.v0i0.1846.

35. Ferragut, C.; Vila, H.; Abraldes, J.A.; Manchado, C. Influence of Physical Aspects and Throwing Velocity in Opposition Situations in Top-Elite and Elite Female Handball Players. *Journal of Human Kinetics* **2018**, *63*, 23–32, doi:10.2478/hukin-2018-0003.
36. Nikolaidis, P.T.; Afonso, J.; Clemente-Suarez, V.J.; Alvarado, J.R.P.; Driss, T.; Knechtle, B.; Torres-Luque, G. Vertical Jumping Tests versus Wingate Anaerobic Test in Female Volleyball Players: The Role of Age. *Sports* **2016**, *4*, 9, doi:10.3390/sports4010009.
37. Milić, M.; Grgantov, Z.; Chamari, K.; Ardigò, L.P.; Bianco, A.; Padulo, J. Anthropometric and Physical Characteristics Allow Differentiation of Young Female Volleyball Players According to Playing Position and Level of Expertise. *Biol. Sport* **2016**, *34*, 19–26, doi:10.5114/biolsport.2017.63382.
38. Romero-Caballero, A.; Varela-Olalla, D.; Loëns-Gutiérrez, C. Fitness Evaluation in Young and Amateur Soccer Players: Reference Values for Vertical Jump and Aerobic Fitness in Men and Women. *Science & Sports* **2021**, *36*, 141.e1-141.e7, doi:10.1016/j.scispo.2020.04.004.
39. Prvulović, N.; Čoh, M.; Čular, D.; Tomljanović, M.; Sporiš, G.; Fišer, S.Ž. Countermovement Jump in Female Sprinters: Kinetic Parameters and Asymmetry. *Symmetry* **2022**, *14*, 1130, doi:10.3390/sym14061130.
40. Bravo-Sánchez, A.; Morán-García, J.; Abián, P.; Abián-Vicén, J. Association of the Use of the Mobile Phone with Physical Fitness and Academic Performance: A Cross-Sectional Study. *International Journal of Environmental Research and Public Health* **2021**, *18*, 1042, doi:10.3390/ijerph18031042.
41. Battaglia, G.; Paoli, A.; Bellafiore, M.; Bianco, A.; Palma, A. Influence of a Sport-Specific Training Background on Vertical Jumping and Throwing Performance in Young Female Basketball and Volleyball Players. *J Sports Med Phys Fitness* **2014**, *54*, 581–587.
42. Serin, E.; Ziyagil, M.A. Comparison of physical characteristics, speed, agility, muscular endurance, aerobic power and recovery abilities between female volleyball and basketball players. *Int J Life Sci Pharma Res.* **2021**, 8, doi:10.22376/ijpbs/ijlpr/SP14/jan/2021.1-383.
43. Hardesty, K.; Hegedus, E.J.; Ford, K.R.; Nguyen, A.; Taylor, J.B. Determination of clinically relevant differences in frontal plane hop tests in women's collegiate basketball and soccer players. *Int J Sports Phys Ther* **2017**, *12*, 182–189.
44. Philpott, L.K.; Forrester, S.E.; van Lopik, K.A.; Hayward, S.; Conway, P.P.; West, A.A. Countermovement Jump Performance in Elite Male and Female Sprinters and High Jumpers. *Proceedings of the Institution of Mechanical Engineers, Part P: Journal of Sports Engineering and Technology* **2021**, *235*, 131–138, doi:10.1177/1754337120971436.
45. Leütterová, D.; Tomková, P.; Dzugas, D.; Kačúr, P.; Gonzalez, P.P. Explosive Strength of Lower Limbs in 10 – 12 Years Old Athletes of Individual Sports. *Acta Facultatis Educationis Physicae Universitatis Comenianae* **2020**, *60*, 94–104, doi:10.2478/afepuc-2020-0008.
46. Moses, M.O.; Bohulu, A.S.; Tetteh-Opai, A.A.; Afrifa, D.; Donkor, C.; Essaw, E.; Yaw, O.R.; Ampong, J.; Abban, E.; Acheampong, I.K. Physiological and Motor Performance Parameters of Female Athlete and Non-Athlete Students in a Ghana University: A Comparative Pilot Study. *Zahedan J Res Med Sci.* **2019**, *21*, 7, doi:10.5812/zjrms.85975.
47. Kukumoni Patir; K Romeo Meetei; Sarungbam Sen Singh; L Santosh Singh Study of physical fitness among the selected combative sports. *International Journal of Physical Education and Sports* **2019**, *4*, 5, doi:10.13140/RG.2.2.27506.53440.
48. World Medical Association Declaration of Helsinki: Ethical Principles for Medical Research Involving Human Subjects. *JAMA* **2013**, *310*, 2191, doi:10.1001/jama.2013.281053.
49. Sandu, A.S. *Etica si deontologie profesionala*; Lumen: Iasi, 2012; ISBN 978-973-166-302-9.
50. Speed and Power Fitness Tests Available online: https://www.topendsports.com/testing/anaerob.htm (accessed on 20 January 2023).
51. Opariuc, D.C. *Statistica Aplicata in Stiintele Socio-Umane. Analiza Asocierilor Şi a Diferenţelor Statistice*; Arhip Art: Sibiu, 2011;
52. Murariu, G. *Fizică Statistică Și Computațională-Aspecte Contemporane Si Aplicații*; Galați University Press: Galati, 2018;
53. Murariu, G.; Munteanu, D. *Lucrări Practice de Identificare, Modelare Şi Simulare a Proceselor Fizice*; Galați: University Press: Galati, 2018;
54. Ostertagová, E.; Ostertag, O.; Kováč, J. Methodology and Application of the Kruskal-Wallis Test. *Applied Mechanics and Materials* **2014**, *611*, 115–120, doi:10.4028/www.scientific.net/AMM.611.115.
55. MacFarland, T.W.; Yates, J.M. Mann–Whitney U Test. In *Introduction to Nonparametric Statistics for the Biological Sciences Using R*; MacFarland, T.W., Yates, J.M., Eds.; Springer International Publishing: Cham, 2016; pp. 103–132 ISBN 978-3-319-30634-6.

56. Dinca, L.; Marin, M.; Radu, V.; Murariu, G.; Drasovean, R.; Cretu, R.; Georgescu, L.; Timiș-Gânsac, V. Which Are the Best Site and Stand Conditions for Silver Fir (Abies Alba Mill.) Located in the Carpathian Mountains? *Diversity* **2022**, *14*, 547.
57. McFarland, I.T.; Dawes, J.J.; Elder, C.L.; Lockie, R.G. Relationship of Two Vertical Jumping Tests to Sprint and Change of Direction Speed among Male and Female Collegiate Soccer Players. *Sports* **2016**, *4*, 11, doi:10.3390/sports4010011.
58. Bayraktar, I. The influences of speed, cod speed and balance on reactive agility performance in team handball. *International Journal of Environmental & Science Education* **2017**, *3*, 12, doi:10.12973/ijese.2017.2140a.
59. Yildiz, S.; Ates, O.; Gelen, E.; Çirak, E.; Bakici, D.; Sert, V.; Kayihan, G. The Relationship between Start Speed, Acceleration and Speed Performances in Soccer. *Universal Journal of Educational Research* **2018**, *6*, 4.
60. Lockie, R.G.; Stecyk, S.D.; Mock, S.A.; Crelling, J.B.; Lockwood, J.R.; Jalilvand, F. A cross-sectional analysis of the characteristics of division i collegiate female soccer field players across year of eligibility. *J. Aust. Strength Cond* **2016**, *24*, 6–11.
61. Mane, S.; Jyoti, D. Comparative Study on Explosive Strength of Basketball and Volleyball Players. *Int. j. physiol. nutr. phys. educ.* **2018**, *3*, 607–609.
62. Trisanda, G.; Wijayanti, N.P.N.; Hidayat, H.; Fiqri, M. The Effect of Single-Leg Speed Hop Exercise on Leg Muscle of Aerobic Athletes. *Journal of Coaching and Sports Science* **2022**, *1*, 13–17.
63. Lockie, R.G.; Schultz, A.B.; Callaghan, S.J.; Jordan, C.A.; Luczo, T.M.; Jeffriess, M.D. A Preliminary Investigation into the Relationship between Functional Movement Screen Scores and Athletic Physical Performance in Female Team Sport Athletes. *Biol. Sport* **2014**, *32*, 41–51, doi:10.5604/20831862.1127281.
64. Dos'Santos, T.; Thomas, C.; Comfort, P.; Jones, P.A. Comparison of Change of Direction Speed Performance and Asymmetries between Team-Sport Athletes: Application of Change of Direction Deficit. *Sports* **2018**, *6*, 174, doi:10.3390/sports6040174.
65. Christensen, B.; Bond, C.W.; Napoli, R.; Lopez, K.; Miller, J.; Hackney, K.J. The Effect of Static Stretching, Mini-Band Warm-Ups, Medicine-Ball Warm-Ups, and a Light Jogging Warm-Up on Common Athletic Ability Tests. *Int J Exerc Sci* **2020**, *13*, 298–311.
66. Bendic, V.; Gilic, B.; Sekulic, D. Associations between Vertical and Horizontal Jumps with Power Values during Deadlift Exercise among Youth Soccer (Football) Players: *Asian Exercise and Sport Science Journal* **2021**, *5*, 55–60, doi:10.30472/aesj.v5i1.222.
67. Rodríguez-Rosell, D.; Mora-Custodio, R.; Franco-Márquez, F.; Yáñez-García, J.M.; González-Badillo, J.J. Traditional vs. Sport-Specific Vertical Jump Tests: Reliability, Validity, and Relationship With the Legs Strength and Sprint Performance in Adult and Teen Soccer and Basketball Players. *The Journal of Strength & Conditioning Research* **2017**, *31*, 196–206, doi:10.1519/JSC.0000000000001476.
68. Podstawski, R.; Markowski, P.; Clark, C.C.T. Sex-Mediated Differences and Correlations between the Anthropometric Characteristics and Motor Abilities of University Students. *JPES* **2020**, *2020*, 86–96, doi:10.7752/jpes.2020.01011.
69. Dobos, K.; Novak, D.; Barbaros, P. Neuromuscular Fitness Is Associated with Success in Sport for Elite Female, but Not Male Tennis Players. *International Journal of Environmental Research and Public Health* **2021**, *18*, 6512, doi:10.3390/ijerph18126512.
70. Delextrat, A.; Cohen, D. Strength, Power, Speed, and Agility of Women Basketball Players According to Playing Position. *The Journal of Strength & Conditioning Research* **2009**, *23*, 1974–1981, doi:10.1519/JSC.0b013e3181b86a7e.