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Science of Gymnastics Journal (ScGYM®) (abrevated for citation is SCI GYMNASTICS J) is an international journal that provide a wide range of scientific information specific to gymnastics. The journal is publishing both empirical and theoretical contributions related to gymnastics from the natural, social and human sciences. It is aimed at enhancing gymnastics knowledge (theoretical and practical) based on research and scientific methodology. We welcome articles concerned with performance analysis, judges' analysis, biomechanical analysis of gymnastics elements, medical analysis in gymnastics, pedagogical analysis related to gymnastics, biographies of important gymnastics personalities and other historical analysis, social aspects of gymnastics, motor learning and motor control in gymnastics, methodology of learning gymnastics elements, etc. Manuscripts based on quality research and comprehensive research reviews will also be considered for publication. The journal welcomes papers from all types of research paradigms.

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EDITORIAL

Dear friends,

In June we moved to open editorial software that is hosted by Ljubljana University. We are still adapting to this new address and the new way of work. We apologise for any inconvenience that this move has created and hope to get everything running smoothly by the end of this year.

Please note that our new address is

https://journals.uni-lj.si/sgj

There has been news from the Web of Science recently: our journal has been evaluated in the Journal Citations Reports. The full report is available at the end of the Journal. As far as we understand it, a report in the JCR is the first step towards calculating the impact factor of a journal. Our results are not spectacular, we will be placed in the 4th quarter (Q4), but to be placed alone is a huge success on its own. Perhaps our articles are like wine, the older they are the more citations they gain.

By the way, in SCOPUS by SNIP we are in the third quarter, very close to the second.

We are still experiencing problems with reviewers, as unfortunately many have no time. Allow me to appeal to you to please help out! We are running a very specialised journal and have access to only limited numbers of researchers. Let us all make an effort to be part of the prominent scientific community on the Web of Science and in SCOPUS!

This issue is mostly dedicated to rhythmic gymnastics with six articles focusing on it. The rest are articles on artistic gymnastics and physical education. Authors are again from all around the world: Tunisia, Oman, United Kingdom, Ukraine, Bulgaria, Brazil, Czechia, Turkey, Croatia, USA and Greece.

The first World Championship in parkour in Japan was historic. It would be great to have a paper on this new gymnastics sport discipline.

Anton Gajdoš prepared his 25rd short historical note introducing Shigeru Kasamatsu from Japan.

Just to remind you, if you cite the journal, its abbreviation in the Web of Knowledge is
SCI GYMN J.

I wish you enjoyable reading and many new ideas for research projects and articles.

Ivan Čuk
Editor-in-Chief

In National museum of contemporary history of Slovenia new exhibition with title “In champions shoes” also presents gymnastics champions since independence in 1991. Visitors (on photo are students of University of Ljubljana, Faculty of Sport) can also try some simple (support with bent legs) and more difficult static elements (Manna), but fantasy in experimenting is always allowed. Photo Svit Mlakar.

EFFECT OF ASSEMBLÉ-STEP ON KINETIC AND KINEMATIC PARAMETERS OF STAG RING LEAPS WITH AND WITHOUT THROW-CATCH OF THE BALL IN RHYTHMIC GYMNASTICS

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Abstract

This study was conducted to compare the kinetic and kinematic factors of stag ring leap with and without throwing the ball using the two-leg take-off ballet-step "Assemblé" between three different modes in rhythmic gymnastics (RG). Seven members of the Tunisian RG national team (age 18.71±2.69 years; height 1.67±0.04 m; weight 58.43±4.03 kg) took part in this study. A kinetic and kinematic analysis of three stag ring leap execution modes (i.e., assemblé stag ring leap without ball, throw ball assemblé stag ring leap and assemblé throw ball stag ring leap) using two cameras on a specially designed floor carpet where a force plate was integrated was conducted. The result showed that the vertical component of force, the rate of force development, the angle of split legs and the horizontal and vertical velocity were significantly different (P<0.01). In this study, it was found that while performing the stag ring leap element, gymnasts present the highest value in both kinetic and kinematic parameters when throwing the ball during the jump (i.e., assemblé throw ball stag ring leap). In light of the obtained results, it is recommended that coaches start working with gymnasts on the throws during the jump from their youngest age, as this could help them attain the optimal performances in competition.

Keywords: *Leap, Run-up, Take-offs, Apparatus.*

INTRODUCTION

Rhythmic gymnastics is defined as an aesthetic purely feminine Olympic sport performed in harmony with musical accompaniment (Akkari-Ghazouani, Mkaouer, Amara, & Chtara, 2020; Bobo-Arce & Méndez Rial, 2013; Chiat & Ying, 2012; Coppola, Albano, Sivoccia, & Vastola, 2020; dos Reis Furtado, de Toledo, Antualpa, & Carbinatto, 2020; Douda, Toubekis, Avloniti, & Tokmakidis, 2008; Putra, Soenyoto, Darmawan, & Irsyada, 2020; Selecká, Krnáčová, & Lamošová, 2020). Gymnasts are awarded scores which are based on a Code of Points

governed by the International Gymnastic Federation (FIG, 2020) and updated every four years.

RG exercises are evaluated by two groups of judges: difficulty (D) and execution (E), under Strand D. They are evaluated on body difficulties (BD) (i.e., jumps, balance, and rotation), dance steps combinations (S), apparatus difficulties (AD) and dynamic elements with rotation (R). They are evaluated on technical and artistic performances (FIG, 2020).

In order to be able to successfully execute her exercise, the gymnast must first work on the essential basic qualities that allow her to successfully execute the different parts of her exercise. We can mention velocity, strength, flexibility, and coordination as the determinant qualities of performance in RG (Abd El-Hamid, 2010; Akkari-Ghazouani et al., 2020; Ashby & Heegaard, 2002; Coppola et al., 2020; Douda et al., 2008; Selecká et al., 2020). Therefore, for better execution of difficulties (i.e., jumps, balances, and rotations), the gymnast should develop these qualities. However, among the body difficulties groups, many studies indicated that the jumps group was the most important and the most studied (Akkari-Ghazouani et al., 2020; Hutchinson, Tremain, Christiansen, & Beitzel, 1998; Kums, Ereline, Gapeyeva, & Paasuke, 2005; Mkaouer, Amara, & Tabka, 2012; Polat, 2018; Purenović, Bubanj, Popović, Stanković, & Bubanj, 2010; Sekuli, Cacute, & Wolf-Cvitak, 2004; Sousa & Lebre, 1996, 1998).

The take-off is the key moment in gymnastics' performance, and it is therefore of interest to coaches and gymnasts who want to specifically improve their jump performances. According to Selecká et al. (2020), the four phases (i.e., preparatory phase, take-off phase, flight phase and landing) must be performed fluently. This would mean that a good start (preparatory phase) allows a good jump. However, the chasse step is the most studied in the literature. It allows a one-leg take-off (Akkari-ghazouani et al., 2020; Coppola et al., 2020). Since the type of the run-up step used during the preparatory phase has no effect on the starting score of the gymnast, making a jump with only one leg or two legs during the take-off does not change anything in the score. Therefore, it is necessary that she chooses the best run-up step which allows her to execute her difficulty. This leads to the idea of analysing the only run-up step that enables two legs on take-off, something called the assemblé. The latter has been studied as a preparatory phase for a front split-leap with the trunk bent backward (Purenović et al., 2010), with a split-leap (Polat, 2018), with stag-leap and back bent (Selecká et al., 2020), and with the stag ring leap without apparatus. Likewise, the throw of the apparatus at the beginning, in the middle or at the end of the jump does not change anything in the score. The only rule imposed by the Code of Points (FIG, 2020) is to make a big throw. This leads us to analyse this technique with two different moments of the throw in order to distinguish the best moment in it to perform a jump with optimal execution factors.

Among the most important leaps that must be acquired by the gymnast, we have chosen the stag ring leap, which is considered one of the fundamental gymnastics skills, and a key movement in the development of elite female gymnasts (Nabanete dos Reis Furtado, de Toledo, Fernandes Antualpa, & Carbinatto, 2020; Selecká et al., 2020).

The aim of this research was to analyse the effect of introducing the ball on the realisation of a stag ring leap, and to determine which of the two techniques allows to have a better jump. We hypothesized that the introduction of the ball might change the performance of the stag ring leap. We also hypothesized a probable increase in jump performance factors when throwing during the jump (i.e., assemblé throw ball stag ring leap) since the throw is made during the take-

off. Such changes would not be observed for the technique of throwing before the jump (i.e., throw ball assemblé stag ring leap).

METHODS

A minimum sample size of 7 participants was determined from an a priori statistical power analysis using G*Power software [version 3.1 University of Dusseldorf, Germany (Faul et al., 2009)]. The power analysis was computed with an assumed power of 0.95 at an alpha level of 0.05 and a moderate effect size of 0.8. Therefore, seven senior rhythmic gymnasts from the Tunisian National Team Senior (n=7; age 18.71±2.69 years; height 1.67±0.04 m; body mass 58.43±4.03 kg; training average 20h/week; years of practice 10.57±1.84 years and years of practice on the national team 6.71±1.27 years) took part in this study. All participants were in good health, without muscular, neurological or tendon injury. After being informed in advance of the procedures, methods, benefits, and possible risks of the study, each participant and/or parent/legal representatives of gymnast (i.e., for gymnasts under 18) reviewed and signed a consent form to participate in the study. The experimental protocol was performed in accordance with the Declaration of Helsinki for human experimentation (Carlson, Boyd, & Webb, 2004) and was approved by the Ethical Committee of the National Centre of Medicine and Science in Sport (LR09SEP01).

The overall idea of this study was to determine the best way to better perform the jumps through improving their phases (Selecká et al., 2020). The specific aim of this research was to scrutinise and compare the kinetic and kinematic factors of stag ring leap using two types of throws: The first is with and without throwing during the run-up step (ASWB Vs TBAS); and the second is with and without throwing the ball during the jump at take-off (ASWB Vs ATBS). These techniques were carried out using the two-leg take-off ballet-step "Assemblé". To our knowledge, this technical combination (i.e., assemblé-step / stag ring leap with and without two types of throwing apparatus) has never been studied/analysed in rhythmic gymnastics.

Before performing the test, every gymnast undertook a 10-min warmup which included specific exercises for flexibility of the lower limbs (static hamstring and split exercise) and the trunk (wheel variations and lumbar mobility). Afterwards, they were allowed to trial the jump 3 times (with a 2-min rest between repetitions) whilst adjusting to making the take-offs on the force-plate. The design of the study was a double-acting approach "kinematic and kinetic", undertaken over 3-days from 14:00 to 16:00 o'clock. The video acquisition is synchronized with the force-plate through the time code "TC-Link".

The experiment was performed on a gymnastics carpet, in which we integrated a force-plate [Kistler Quattro Jump, type: 9290AD, ref. 2822A11, sampling frequency 500 Hz]. Thereafter, each gymnast was called to randomly perform three modes of execution of stag ring leap with and without throw-catch of ball using the assemble-step for the take-off with two legs:

(a) Assemblé stag ring leap without ball [ASWB] (Figure 1a): The gymnast stood in a straight body position with both feet together. She made a step in which the working foot slid on the ground before being swept into the air; as the foot went into the air the dancer pushed off the floor with the supporting leg, extending the toes. Both legs came to the ground simultaneously in the fifth position (ABT, 2006). Then she pushed up from the floor with two legs; when mid-air, she pulled one leg flexed forward and the other flexed behind.

The arms must move with the jump to propel the jump higher to land. She then pulled legs back into the original position and landed gently back to a straight body position.

(b) Throwing ball on the assemblé (i.e., in the run-up phase) and catch it on the stag ring leap (i.e., in the landing phase) [TBAS] (Figure 1b): In this second technique, the gymnast should throw the ball on the assemblé and catch it on the stag ring leap.

(c) Assemblé and throw ball on the stag ring leap jumping phase and catch on the landing phase [ATBS] (Figure 1c): In this last technique, the gymnast should throw the ball in the technical element (i.e., in the take-off phase) and catch it at the end of the jump (i.e., in the landing phase) using the assemblé as a run-up step for the take-offs.

For each technique, the gymnast performed three trials [randomized protocol, Latin Square (Zar, 1984)], with 2-minute recovery between repetitions, supervised by two international judges. The best performance selected by the judges was chosen to be used in the comparative study. The only advice to the participants was to make the take-off on the force-plate. The execution was neither limited by a time nor imposed rules.

To record the skill, two Sony DCR PC105^{E} cameras [1-megapixel CCD, 50 fps, 1 Lux minimum sensitivity] with wide conversion lens were used. They were positioned to capture the entire movement of the experience. The first was on the frontal plane 5m from the mat and the second was on the sagittal plane 3m from the mat. Passive markers were taped to each gymnast to carry out the kinematic analysis on the basis of the Hanavan model (Hanavan & Ernest, 1964) modified by De Leva (1996). This basic model includes 20 points and 14 segments distributed throughout the body. Data digitalization was realized via a video-based motion and skill analysis system, SkillSpector® [Version 1.3.2, Odense SØ – Denmark] (Brønd & Elbæk, 2013) with quantic-spline data filtering. The video acquisition was achieved with the FireWire bus [iLink / IEEE 1394], in full frame without compression. The construction of key positions and 2D kinograms was developed by Adobe Illustration© [1987-2019 Adobe].

Maximal vertical force (Fy) and maximal rate of force development (RFD) of the stag ring leap take-offs were analysed via direct kinetic data, and the centre of mass' displacement (dx_{COM} and dy_{COM}) and velocity (Vx_{COM} and Vy_{COM}) were analysed via manual digitized kinematic data. The angular data of the angle of split legs ($Ang S_{leg}$) during the stag ring leap were also analysed.

Statistical analysis was conducted via SPSS 20.0 software [SPSS. Chicago. IL. USA]. Descriptive statistics (means ± SD) were performed for all variables. The effect size (*d*) was conducted using G*Power^{TM} software [Version 3.1, University of Dusseldorf, Germany (Faul, Erdfelder, Buchner, & Lang, 2009)]. The following scale was used for the interpretation of *d*: < 0.2, trivial; 0.2 – 0.6, small; 0.6 – 1.2, moderate; 1.2 – 2.0, large; and > 2.0, very large (Hopkins, 2002). The normality of distribution estimated by the Kolmogorov-Smirnov test was acceptable for all variables ($p>0.05$). Consequently, a one-way ANOVA with repeated measures was used for all variables (kinetic and kinematic) to benchmark different stag ring leaps. The Bonferroni test was applied in post-hoc analysis for pairwise comparisons. Additionally, effect sizes (*d*) were determined from ANOVA output by converting partial eta-squared to Cohen's *d* [small = 0.01, medium = 0.06, and large = 0.14 (Cohen, 1988)]. A priori level less than or equal to 0.5% ($p\leq0.05$) was used as a criterion for significance.

RESULTS

The results of ANOVA repeated measure showed that there is a significant difference, in both kinetic and kinematic parameters, between the three execution modes (i.e., ASWB, TBGS and ATBS). This difference can be related to the introduction of the apparatus, which is a pre-requisite component for RG, and also to the moment of its throwing. There is a significant difference in the execution parameters of stag ring leap ($p<0.01$) except for the horizontal and vertical displacement of the COM (dx_{COM}, dy_{COM}) which remains almost stable (Table 1).

Pairwise comparison (i.e., Bonferroni post-hoc test) showed that the three execution modes had different effects on the execution factors of the stag ring leap (Table 2). The vertical component of force (Fy) increases significantly when the ball is introduced ($p<0.05$), specifically during the technique of throwing at take-off (ATBS Δ ASWB = 44.35%) (Figure 2a). Similarly, for the RFD, which was increased significantly at $p<0.001$ during both jumps with ball (ATBS Δ ASWB = 77.99%) (Figure 2b). Also, the analysis showed a significant increase ($p<0.01$) in the horizontal velocity (Vx_{COM}) when introducing the ball (TBAS Δ ASWB = 39.88% and ATBS Δ ASWB = 55.70%) (Figure 2c). On the other side, the vertical velocity (Vy_{COM}) decreases significantly at $p<0.05$ when the ball is thrown at run-up compared to take-off (TBAS Δ ATBS = -6.67%) (Figure 2c). Finally, for the angle of split legs ($AngS_{leg}$), it was significantly higher ($p<0.05$) when throwing the ball during the stag ring leap take-off (i.e., ATBS) (Figure 2d).

Table 1
ANOVA repeated measure of the three stag ring leaps execution modes.

	ICC	CV	df	Mean Square	F	Sig.	Effect size *(d)*	Power
dx_{COM} (m)	0.647	0.150	2	0.006	2.506	0.530	0.544	0.406
dy_{COM} (m)	0.828	0.187	2	0.213	1.680	0.456	0.617	0.161
Vx_{COM} (m/s)	0.514	0.226	2	0.452	27.922	0.001	4.3126	1.000
Vy_{COM} (m/s)	0.661	0.082	2	0.224	8.866	0.004	2.4292	0.920
$AngS_{leg}$ (°)	0.828	0.051	2	406.286	7.371	0.008	2.2156	0.864
Fy (N)	0.580	0.230	2	2705639.955	15.226	0.007	3.1834	0.906
RFD (N/s)	0.583	0.314	2	431969.439	61.918	0.001	6.4385	1.000

(dx_{COM}) Horizontal displacement of the Centre of mass; (dy_{COM}) Vertical displacement of the Centre of mass; (Vx_{COM}) Horizontal velocity of the Centre of mass; (Vy_{COM}) Vertical velocity of the Centre of mass; ($AngS_{leg}$) Angle of split legs; (Fy) Vertical Force; (RFD)Rate of force development.

Table 2
Post-Hoc comparative study between the three stag ring leaps execution modes.

		Mean ± SD		*Mean Difference*	*Standard Error*	*Sig.*	*Effect size (d)*	*Delta variation (Δ%)*
Vx_{COM} (m/s)	ASWB vs TBAS	0.885 ± 0.052	1.238 ± 0.056	-0.353	0.054	0.002	6.53	-39.88
	ASWB vs ATBS	0.885 ± 0.052	1.378 ± 0.052	-0.493	0.084	0.003	5.86	-55.70
Vy_{COM} (m/s)	TBAS vs ATBS	2.312 ± 0.63	2.669 ± 0.092	-0.357	0.089	0.021	4.01	-6.67
$AngS_{leg}$ (°)	TBAS vs ATBS	179.571 ± 4.325	194.143 ± 4.372	-14.571	3.618	0.021	4.02	-8.11
Fy (N)	ASWB vs ATBS	1767.429 ± 99.473	2551.321 ± 112.009	-783.893	204.445	0.026	3.83	-44.35
	TBAS vs ATBS	1790.821 ± 80.014	2551.321 ± 112.009	-760.500	188.605	0.021	4.03	-42.46
RFD (N/s)	ASWB vs ATBS	624.685 ± 35.312	1093.152 ± 24.090	-468.467	53.906	0.000	8.69	-74.99
	TBAS vs ATBS	715.623 ± 23.491	1093.152 ± 24.090	-377.529	20.840	0.000	18.11	-52.75

(Vx_{COM}) Horizontal Velocity of the centre of mass; (Vy_{COM}) Vertical velocity of the centre of mass; ($AngS_{leg}$) Angle of split legs; (Fy) Vertical Force; (RFD) Rate of force development; (ASWB) Assemblé and Stag ring Leap Without Ball; (TBAS) Throw Ball during the Assemblé and Stag ring Leap; (ATBS) Assemblé and Throwing Ball during the Stag ring Leap.

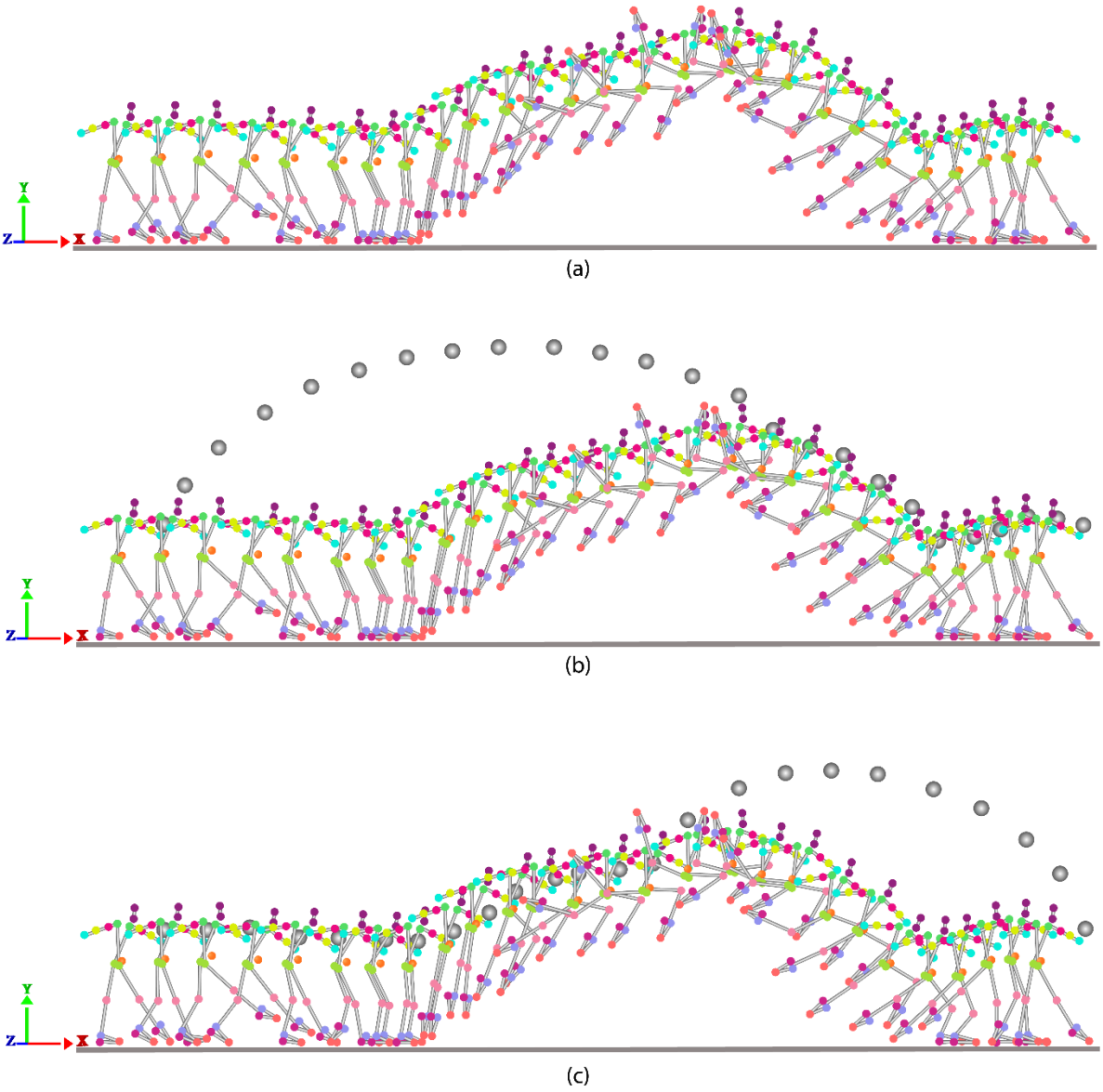

Figure 1. Experimental protocol: (a) Assemblé and stag ring leap without ball (ASWB), (b) Throwing ball during the assemblé and stag ring leap (TBAS), (c) Assemblée and throwing ball during the stag ring leap with ring (ATBS).

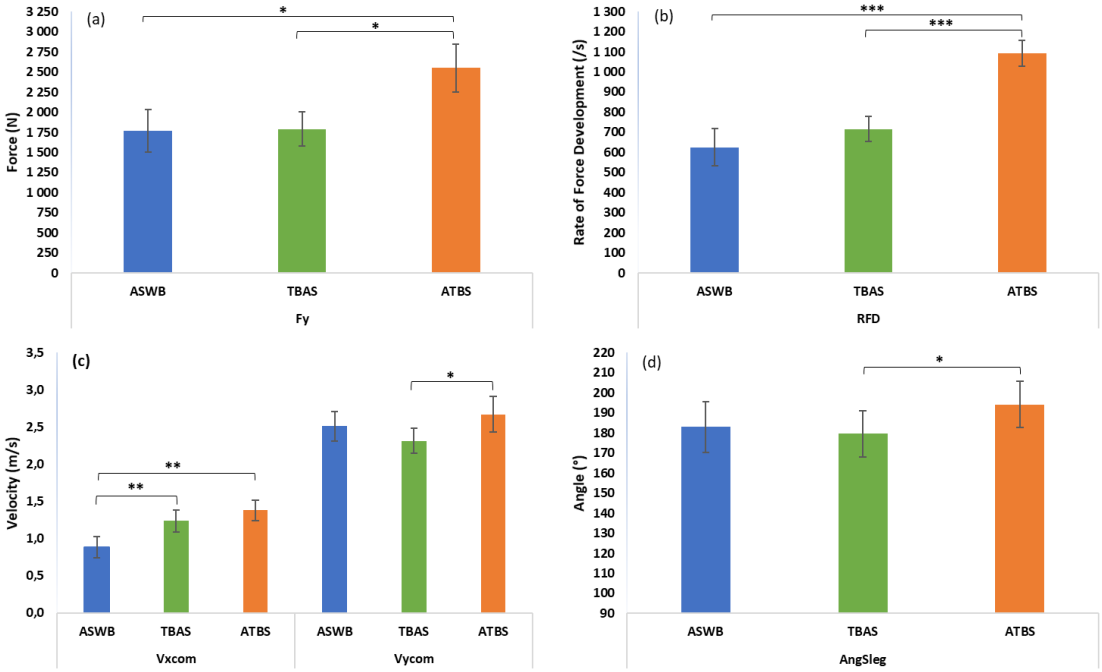

Figure 2. The determinants of performance that varied in the three execution modes of the stag ring leap: (a) Vertical force; (b) Range of force development; (c) vertical and horizontal velocity; (d) Angle of split legs. [(*) significant at $p<0.05$; (**) Significant at $p<0.01$; (***) Significant at $p<0.001$; (ASWB) Assemblé and stag ring leap without ball; (TBAS) Throwing ball during the assemblé and stag ring leap; (ATBS) Assemblée and throwing ball during the stag ring leap with ring].

DISCUSSION

The aim of this study was to investigate the impact of 'two leg take-off' using a ballet-step "Assemblé" on kinetic and kinematic parameters of stag ring leap, and also to explore the effect of introducing the ball as well as the best moment for throwing.

The obtained results are significantly different between the three modes, with a higher value with apparatus, especially when throwing the ball during the stag ring leap. Kinetic study showed that the vertical force and the rate of force development varied significantly during the three stag ring leaps. The force is considered as the source of motion (Stone, Stone, & Sands, 2007) and the peak is recorded during the ATBS. This result can be linked to the arms action at take-off. According to several studies, the arms action can generate a ground reaction force (Mkaouer et al., 2014; Vaverka et al., 2016).

Ratamess (2021) showed that the action of the arms, i.e., their swing, includes an explosive forward and upward movement of the arms with thumbs up. This could explain the difference between ASWB and ATBS. The two stag ring leap modes train with swinging arms, but the ATBS trains with a ball. This could demonstrate that throwing a ball with a vertical arms movement could enhance Fy and RFD. In fact, by throwing the ball, the gymnast stretches her thumbs to ensure the proper direction.

These results are not in accordance with those reported by Mkaouer et al. (2012). They later concluded that the vertical force developed was more important than the jump with apparatus. It could be claimed that the reason for this was that the jump was performed with a

take-off from one foot, while in our research the jump was performed with take-off from two feet, which were in accordance with Bubanj et al. (2010), who stated that the force in the two-legs jump was better than one-leg jump.

An important component to consider when studying jumping ability is the vertical velocity (Vy) (Haguenauer, Legreneur, & Monteil, 2005). Based on the kinematic study, the vertical velocity was higher when throwing the ball compared to the technique without apparatus, with a clear advantage to the ATBS. This result was contradictory to the one found by Akkari-Ghazouani et al. (2020) who analysed the stag ring leap with a one leg take-off using the chasse step. The difference could be explained by the type of take-off made, which confirms that velocity was better when the jumps are executed with both legs take-off compared to one leg take-off (Bubanj et al., 2010; Purenović et al., 2010).

According to Vescovi (2008), when leg movements are coordinated with arm movements, there is an improvement in vertical velocity. On the other hand, with apparatus, the gymnasts present a vertical velocity that is more important during the ATBS than the TBAS, it may be related to the throwing mode of the ball, considering that in the ATBS there is an asymmetrical arms movement, while in the TBAS this action is blocked to give more attention to the ball.

Moreover, the obtained results show that there was a significant change in the horizontal velocity of the stag ring leap performed by elite gymnasts when introducing the ball. Acting on the result, it was shown also that the ATBS is better than TBAS. The results also indicated that whenever vertical velocity increases, the horizontal velocity decreases, which according to Zatsiorsky (2008), can be due to the fact that the jumper pushes forward on the ground during the take-off phase and therefore receives a backward reaction force from the ground.

The development of gymnasts' flexibility, especially the angle of split legs, is among the most important factors of success (Douda, Tokmakidis, & Tsigilis, 2002; Douda et al., 2008; Nelson, Johnson, & Smith, 1983). According to Putra et al. (2020), split jumping (i.e., leap, stag-leap, wall-monkeys, scissors leap) is one of the movements that has beauty, and the appearance of motion that shows the flexibility and flexibility of the joints as wide as possible, especially the hip joint (Batista Santos, Lemos, Lebre, & Ávila Carvalho, 2015) which must not be less than 180° in order to count as a valid jump (Putra et al., 2020). Our results showed significant differences between the TBAS and the ATBS, which can be explained by the fact that the moment of action of throwing the ball (i.e., the assemblé-step vs. the take-off phase) influences the stag ring leap. Thus, throwing the ball at the jump (i.e., the take-off phase) helps to increase the time of flight and the execution velocity. This allows the gymnast to have more time to better open her angle of split legs. This result allows us to conclude that throwing the ball during jumps enables a better opening of the legs than during run-ups, and therefore, a more beautiful jump that could have better chances to be highly valued by the judges.

The practice of this run-up step is important for coaches, as it offers a variety of preparatory steps for take-offs with two legs. At the same time, apart from training, it is required to practice the assemblé in exercises by practicing and introducing it in the gymnast's routine. The gymnasts themselves become aware of the fact that take offs with two legs helps achieve a good performance of the jump.

CONCLUSION

The aim of this study was to compare the kinetic and kinematic variables between three stag ring leaps with and without throwing the ball, performed using the assemblé-step as a preparatory phase

for two legs take-off in RG. In light of this research, our hypothesis was confirmed. The introduction of the ball changed the parameters of jump performance. With apparatus, it was better to throw it during the jump than to throw it before (i.e., at the run-up). Choosing the ATBS could be considered the optimal technique in the economy of effort, enabling higher values in both kinetic and kinematic parameters (i.e., force, velocity, and flexibility). The findings of the present study could improve the evolution of the preparatory phase while varying the take-off steps, which subsequently could lead to better jumps with better execution on the technical and aesthetic sides. Coaches should therefore be familiar with the biomechanical analysis of jumps to apply it in practice and to improve performance.

Finally, this study has some limitations related to the analysis system used. It would be better to use a triaxial force-plate and a real-time motion analysis system in future studies.

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THE INFLUENCE OF THE "RHYTHMIC GYMNASTICS FOR PRESCHOOLERS" PROGRAM ON THE CULTURE OF MOVEMENT IN 5-6-YEAR-OLD CHILDREN

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Abstract

Existing educational programs for preschool children do not consider the movement culture as a component in the development of child's general culture. In physical culture and health-improving classes in preschool educational institutions, much attention is paid to quantitative indicators that characterize motor qualities. Teachers pay less attention to the technique and beauty of the movement performance. The purpose of the study is to experimentally confirm the effectiveness of the "Rhythmic gymnastics for preschool children" program on the movement culture of children aged 5-6 years. An analysis and generalization of scientific and methodological literature, pedagogical observation and experiment, testing, methods of mathematical statistics. The study involved 80 children who were divided into 2 groups, experimental and control group, 40 children in each. The effectiveness of "Rhythmic gymnastics for preschoolers" was determined on the basis of different results in each component before and after the experiment in each group. The children in the control group improved their results. However, this increase is not reliable (p> 0.05). The physical component improved for all children in the experimental group, but not in all tests for each child. We discovered that authors do not share their views on the concept of "movement culture". The "Rhythmic gymnastics for preschoolers" program is an effective tool to develop preschoolers' movement culture.

Keywords: *Physical fitness, Movement culture, Motor preparedness, Aesthetic abilities.*

INTRODUCTION

In modern scientific research (Yeremushkin, 2016; Nasonova, 2016), the phenomenon of movement culture is increasingly acquiring a general pedagogical character (Honchar et al., 2019). The culture of movement is a motor-executive component of culture that includes the culture of movement in general as well as its theory, practice and analysis, and pedagogical, aesthetic and social aspects of motor activity (Malyshkin, 2012; Sidorova, 2002). Korenberg (2008) mentions that the culture of movement is a system body movements, and in order to develop one's movements to a high level, one needs general and targeted coordination and a certain "movement taste", i.e., understanding the beauty and grace of body movements.

The existing educational programs for preschool children do not separate the culture of movements as a component of

general culture. In physical culture and health-improving classes at preschool educational institutions (PEI), much attention is paid to quantitative indicators, repetitions, timing, meters, kilograms, and other metrics that characterize motor qualities (Moskalenko et al., 2020). The technique and beauty of performing movements is paid attention by teachers to a lesser extent.

Some researchers (Khudolii et al., 2015), and our previous studies have shown (Honchar & Borysova, 2019) that 23.7% of children cannot walk correctly. When performing the “walking” test, it was observed that children did not maintain the correct posture or did not perform active leg flexion in the knee joint and free arm flexion.

Only 12.5% of children met one or two criteria out of four when performing a 10m run. 27.3 % children did not meet any of the criteria. Children had issues with vigorous lifting of the legs, and there was no rhythmic and straight running. A similar situation was observed in the "Standing long jump“ tests. This situation is primarily the result of insufficient development of coordination abilities. In the future, it will have a negative impact on the quantitative indicators when testing walking, running, and standing long jump. We believe that the introduction of rhythmic gymnastics is one solution to this problem.

Researchers have proven that rhythmic gymnastics is effective for the development of coordination abilities, especially in preschoolers (Karpenko et al., 2003; Gantcheva et al., 2021; Kiuchukov et al., 2019); it also helps children learn new movements and master a variety of complex exercises with objects (Khudolii and Yermakov, 2011). It contributes to the development of fine visual motor skills, the ability to maintain static and motion balance, vestibular stability and orientation in space. Performing exercises, modevelopment of expressiveness and rhythm in children (Viener-Usmanova et al., 2014).

The purpose of the study is to experimentally confirm the effectiveness of the "Rhythmic gymnastics for preschoolers" program to develop movement culture in children aged 5-6 years.

METHODS

The study involved 80 children who were divided into 2 groups of 40 children in each (Table 1).

Table 1
The division of children by age.

	Number of children (n=80)							
	Group 1 (n=40)				Group 2 (n=40)			
	5year-old	%	6-year-old	%	5-year-old	%	6year-old	%
Girls	16	40,0	6	15,0	13	32,5	11	27,5
Boys	14	35,0	4	10,0	11	27,5	5	12,5
Total	30	75,0	10	25,0	24	60,0	16	40,0

Anthropometric indicators (body length, body weight, chest and head circumference) in most children showed average values. The division of the children into groups was carried out by taking into account their age and sex, and the peculiarities of preschool institutions.

The research was carried out in two educational institutions for preschool education in Dnieper City. Children in Group 1 of kindergarten № 123 ‘Fairy’ (40 children: 22 girls and 18 boys) followed the program ‘I am in the world’ recommended by the Ministry of

Education and Science of Ukraine (Kononko et al., 2019), and the optional component consisted of exercises for building the correct posture and preventing flat feet. Children in Group 2, kindergarten № 355 'Dream' (40 children: 24 girls and 16 boys) followed the program 'I am in the world' and during the optional component performed exercises and tasks developed by us, i.e., they followed the "Rhythmic gymnastics for preschool children" program.

Analysis and generalization of scientific and methodological literature and Internet resources to determine the goals and objectives of physical education for preschoolers, effective means, and methods that shape the culture of movement, especially in preschoolers, that are used in Ukraine, and in physical education around the world.

Pedagogical testing

At the beginning and end of the study, testing was carried out to determine the initial and final situation in the culture of movement for children aged 5-6 years. We determined this by means of physical, motor and aesthetic components.

Assessment of the physical component (physical fitness) of 5-6year-old children was carried out using tests that are recommended by experts in preschool education (Vilchkovsky, and Denisenko, 2011), include all motor qualities, and are used as an assessment tool for its effectiveness in preschoolers' physical education.

1. Speed. A) "Hand movements within 5 sec." Movements with the right and left hand were performed at the table in a group. The children were offered a piece of paper with a line separating it in two sections, and a pencil. At the command "Start", children drew dots on the paper in a free order with maximum speed. On the command "Stop", the movement ended. The number of points was counted. B) "Jumping in place within 5 sec"- the child stands in the starting position in the center of a hoop, hands on the belt. About 5-8cm above the child's head, the researcher holds a sheet of paper. On "Start", the child starts jumping to touch the sheet of paper with the top of his head; on "Stop", he stops. The number of head touches are recorded after three attempts.

2. Agility ("Jumping with turns" to the right and left) - the child stands in the starting position, hands on a thick paper attached to the floor with degree markings. The child performs three jumps, first with a turn to the right, and then to the left.

3. Flexibility. "Torso tilt".

4. Strength. "Dynamometry" with the right and left arms – the test is performed using a child dynamometer, which is put in the child's hand, with the arrow towards the palm. The child takes his hand to the side and presses on the dynamometer. The best result out of three attempts of the right and left hands is recorded. During the test, the hand with the dynamometer should not be touching anything.

5. Endurance. "Hanging on the bar".

The results obtained were compared with standard indicators. For their performance, children could get between 5 and 2 points, where 5 points corresponds to a high level of physical fitness, 3 points to an intermediate level, and 2 points to a low fitness level.

Motor preparedness - this is a process of purposely developing physical qualities that a person needs to learn various physical exercises, and the ability to apply them in everyday life.

Assessment of the motor component in preschoolers was carried out by an expert by means of the same tests set (Vilchkovsky, and Denisenko, 2011):

1. "10m walking" (sec) – Each child walks at an average pace twice, the best result is recorded. The timing starts from the moment the child starts walking and ends when crossing the finish line. The criteria for the quality of walking performance: correct posture; free movements with arms bent at the elbows; energetic and rhythmic steps with rolling

from heel to toe; active flexion and extension of the knees and joints; ability to hold different directions while walking and change them.

2. "10m running" (sec). On the teacher's command, the child runs at maximum speed. The researcher records the time the child covered the distance of 10 meters. The test is performed twice with a rest interval of 4-6 minutes. The best result is recorded. The criteria for the quality of running performance: slight tilt of the body while keeping the head straight; free back and forward movements with arms bent at the elbows; vigorous raising of the swinging leg hip; careful slowing down and swinging legs; movements should be rhythmic and light.

3. "Standing long jump" (cm). Children performed standing long jump 3 times. The best result was recorded. The criteria for the quality of the jump performance: correct starting position; pushing off with two legs followed by their straightening, and vigorous swing of the arms forward and upward; during the flight, the legs are bent and energetically extended forward; stable landing on two bent legs with a transition from the heel to the whole foot; arms forward to the sides.

We assessed quantitative and qualitative indicators of these exercises (5, 3, or 2 points). The final assessment of the motor component score was the mean of the scores after the three tests. If a child received an assessment in the range from 4 to 5 points - his physical fitness was good, from 3 to 4 points - satisfactory, less than 3 points - insufficient (unsatisfactory).

Assessment of the aesthetic component (aesthetic abilities) of the movement culture was carried out according to the Viner-Usmanova method (Viener-Usmanova et al., 2014). To perform this test, the children were divided into two groups, girls and boys. Children were offered classical music and children's rhythmic songs to modern and foreign music.

Children themselves chose and performed movements, which in their opinion were vivid, expressive and emotionally expressed the music. The time to complete the test was one minute. The assessment criteria were the following indicators: motor expressiveness, emotional expressiveness, and imagery. The assessment was carried out using a point scale.

The pedagogical experiment focused on the implementation of a program designed to develop movement culture in children aged 5-6 years called "Rhythmic gymnastics for preschoolers" (Copyright Certificate No. 99827 dated September 22, 2020) and on assessment of its effectiveness. The developed program is designed to cover a 9-month period. Due to the quarantine restrictions, the experiment lasted 6.5 months (from September 2019 till March 12, 2020).

The program provides an introduction to rhythmic gymnastics by using various forms of PEI work and helps develop all components of the movement culture. The program consists of exercises without apparatus (jumping, balances, turns, waves) and with apparatus (rope, hoop, ball); drill and general developmental exercises; general physical fitness exercises; dance, musical and movement exercises, and their connections. The program includes a tutorial and other didactic and musical material.

The study used the calculation of the mean data, the average statistical deviations, the student criterion. The calculation of growth was performed by the Brody index with assessment of reliability of the increase.

$$IB = \frac{100(V_2 - V_1)}{0{,}5(V_1 + V_2)} \% \qquad (1)$$

Where V 1 is the start result, and V2 is the final result.

Table 1
The scale for assessing the aesthetic component of the culture of movement in children aged 5-6 years.

No	Criteria	Assessment
	Motor expressiveness	
1.	Transferring the image in most of the exercise	3
2.	Episodic transmission of the image during the exercise	2
3.	Stiffness of body movements when projecting an image arising from the character of the piece of music	1
	Emotional expressiveness	
1.	Facial expressions partially do not coincide with the nature of the music	3
2.	Unnatural facial expression in certain parts of the exercise, disfiguring the artistic image	2
3.	Mimicry does not correspond to the given musical accompaniment	1
	Imagery	
1.	Stiffness of some movements	3
2.	Stiffness of movements in certain parts of the composition	2
3.	Movement partially or completely does not coincide with the character of music.	1

RESULTS

The culture of movement is an integrated indicator with different components. The model of preschoolers' movement culture, developed by us, consists of the results of testing the physical and motor preparedness and aesthetic abilities in children. The contribution of each of the components to the overall model depends on the score in a particular test.

At the beginning of the experiment, we determined that children in Group 1 were significantly better ($p<0.05$) than children in Group 2 in all components of the movement culture. This is due to the different approach to conducting classes in different preschool institutions. In kindergarten № 355 "Dream", physical education classes were conducted by a group of teachers, and in kindergarten № 123 "Fairy" by a physical education instructor.

After the experiment, we compared the model of the movement culture with the obtained results for each component of the movement culture. Looking at Figure 1, one can see that children in Group 1 improved their results ($p> 0.05$) but not considerably.

Additional exercises aiming to correct posture and flat feet were effective, but not sufficiently to develop the culture of movement in preschoolers. In Group 1, the indices of motor preparedness improved (by 5.65%, $p <0.05$) only in 35% of children . The aesthetic component improved in 17.5% of the children (5.00, $p <0.05$). The greatest increase in the indices of the physical component was observed in the tests "Hand movements" with the right hand (10.32, $p <0.05$).

In Group 2, 60% of children improved their performance in the motor component tests . Evaluating the results obtained, it was observed that children who improved quantitative indicators in jumping tests at the same time increased their marks for the technique of performing jumping in place. A similar trend was observed when performing dynamometry and the "hanging on the bar" test.

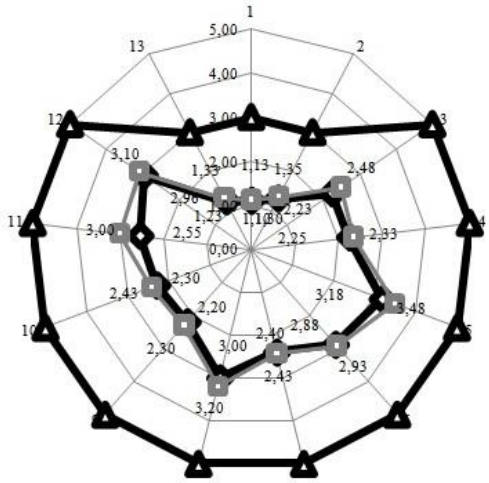

Figure 1. Distribution of 5-6yearold children in Group 1 by the level of culture of movement before and after the experiment.

Note: 1 - Emotional expressiveness; 2 – Imagery; 3 - Movement with the right hand; 4 - Movements with the left hand; 5 - Jumping in place; 6 - Jumping with the right rotation; 7 - Jumping with the left rotation; 8 – Torso tilt; 9 - Dynamometry, right; 10 - Dynamometry, left; 11 - Hanging on the bar; 12 - Motor preparedness, 13 - Motor expressiveness.

before the experiment *after the experiment* *the model of movement culture*

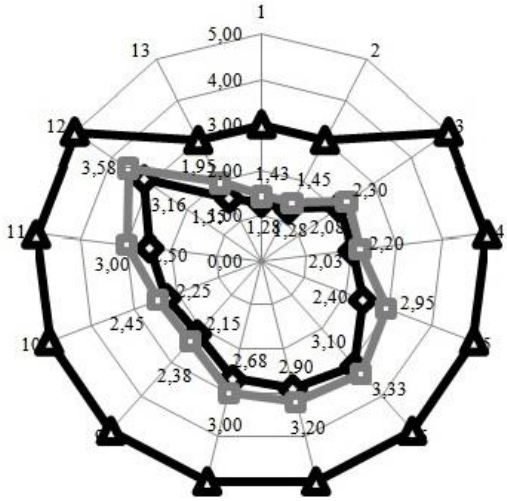

Figure 2. Distribution of 5-6-yearold children in Group 2 according to the level of culture of movement before and after the experiment

Note: 1 - Emotional expressiveness; 2 – Imagery; 3 - Movement with the right hand; 4 - Movements with the left hand; 5 - Jumping in place; 6 - Jumping with the right rotation; 7 - Jumping with the left rotation; 8 – Torso tilt; 9 - Dynamometry, right; 10 - Dynamometry, left; 11 - Hanging on the bar; 12 - Motor preparedness, 13 - Motor expressiveness.

before the experiment *after the experiment* *the model of movement culture*

Table 2
Indicators of the movement culture components in Group 1 ($\bar{x} \pm S$).

	Test		Before the experiment	p	After the experiment	Increase %
Boys	Physical component					
	Hand movement	Right.	16.72±5.33	= .53	17.78±4.62	7.93
	within 5s., times	Left.	16.83±5.09	= .60	17.67±4.35	6.66
	Jumping within 5s., times		12.22±4.44	= .18	14.06±3.47	16.54
	Jumping with	Right.	165.00±48.81	= .32	178.89±31.27	11.25
	rotation, degrees	Left.	146.67±42.29	= .40	157.50±34.22	8,70
	Torso tilt, cm.		6,28±3,79	= .79	6.61±3.57	8.55
	Dynamometry, kg.	Right.	5.86±1.82	= .56	6.22±1.89	6.23
		Left.	6.06±1.75	= .81	6.19±1.69	2.60
	Hanging on the bar, s.		20,67±5,05	= .06	24.17±5.71	15.70
	Motorcomponent					
	10m walking, s.		7.11±0.88	= .59	6.97±0.63	1.69
	10m runninig, s.		3.97±0.88	= .62	3.83±0.79	3.28
	Standing long jump, cm.		71.28±15.85	= .75	72.94±15.49	2.43
	Aestheticcomponent		3.56±0.78	= .52	3.72±0.75	4.78
Girls	Physical component					
	Hand movement	Right.	16.05±6.14	= .28	18.05±6.04	12,29
	within 5s., times	Left.	15.27±4.56	= .22	17.00±4.63	10,84
	Jumping within 5s., times		13,55±3,65	= .74	13.91±3.50	2.99
	Jumping with	Right	166.36±43.57	=1.00	166.36±43.57	0,00
	rotation, degrees	Left.	134.09±38.41	=1.00	134.09±38.41	0,00
	Torso tilt, cm.		6,59±4,11	= .59	7.23±3.65	18.80
	Dynamometry, kg.	Right.	5.48±1.76	= .80	5.61±1.79	2,31
		Left.	5.39±1.53	= .72	5.55±1.43	3,50
	Hanging on the bar, s.		22,36±13,58	= .39	25.77±12.63	17.50
	Motor component					
	10m walking, s.		7.46±1.53	= .37	7.14±0.65	3.27
	10 m runninig, s.		4.03±0.89	= .71	3.93±0.88	2.49
	Standing long jump, cm.		69.27±15.16	= .79	70.50±14.57	1.97
	Aesthetic component		3.68±0.84	= .46	3.86±0.77	5.19

Table 3
Indicators of the movement culture components of children in Group 2 ($\bar{x} \pm S$).

	Test		Before the experiment	p	After the experiment	Increase %
Boys	Physical component					
	Hand movement within 5s., times	Right.	10.38±3.36	= .03	14.38±6.23	26,26
		Left.	9.85±1.68	= .04	13.85±5.63	21,54
	Jumping within 5s., times		11,08±2,02	=.09	12.62±2.63	11.45
	Jumping with rotation, degrees	Right.	214.62±64.05	= .34	226.92±41.21	15,68
		Left.	166.15±69.68	= .12	200.00±36.80	24,95
	Torso tilt, cm.		4,23±1,79	= .22	5.00±1.41	26.68
	Dynamometry, kg.	Right.	4.65±1.36	= .21	5.30±1.77	18,83
		Left.	5.27±1.86	= .51	5.48±2.05	6,72
	Hanging on the bar, s.		17,92±8,99	= .22	23.15±10.57	20.20
	Motor component					
	10m walking, s.		7.26±1.36	= .43	6.99±1.30	4.68
	10m runninig, s.		3.53±0.46	= .05	3.23±0.37	8.19
	Standing long jump, cm.		76.00±10.27	= .38	79.31±9.72	4.42
	Aesthetic component		4.13±1.36	= .12	4.94±1.48	18.67
Girls	Physical component					
	Hand movement within 5s., times	Right.	11.25±3.33	= .27	12.63±5.01	8,72
		Left.	11.04±2.39	= .11	12.88±4.93	10,96
	Jumping within 5s., times		10,13±2,54	= .01	12.21±2.81	12.28
	Jumping with rotation, degrees	Right	142.50±50.82	= .12	163.13±39.39	16,11
		Left.	159.38±67.64	= .42	174.38±59.81	11,90
	Torso tilt, cm.		5,33±3,19	= .52	5.92±3.05	14.33
	Dynamometry, kg.	Right.	5.31±1.52	= .45	5.65±1.49	6,68
		Left.	4.73±1.44	= .36	5.10±1.38	8,58
	Hanging on the bar, s.		21,38±13,53	= .38	24.71±12.72	17.86
	Motor component					
	10m walking, s.		6.90±0.73	= .58	6.79±0.71	1.68
	10m runninig, s.		3.49±0.42	= .35	3.39±0.35	2.89
	Standing long jump, cm.		74.26±13.26	= .63	75.92±12.01	2.76
	Aesthetic component		4.08±1.41	= .14	4.75±1.62	14.73

Children in Group 2 learned to control their emotions and concentrate on performing activities. This can be seen in the results of “hand movement”, “dynamometry”, “pivot jump” tests, and all tests of the aesthetic component. 20% of children in the experimental group did these tests at a high level. Before the test, it was noticeable how children started thinking, calmed down and clearly performed each motor activity as instructed by the teacher. In Group 1, only 2.5% of the children managed to complete tasks with such focusThe physical component of the movement culture improved in all children in Group 2, but not in all tests and in each child. The greatest increase was observed in the tests: “hand movements” with the right hand (15.44%, $p < 0.05$), “jumping in place” (15.55 %, $p < 0.05$), “jumping with a turn” to the right (15.94%, $p < 0.05$) and to the left (17.12%, $p < 0.05$), “torso tilt” (19.27%, $p < 0.05$) and "hanging on the bar" (18.80%, $p < 0.05$).

Thus, the implementation of the "Rhythmic gymnastics for preschoolers" program is an effective means for the development of movement culture in preschoolers and can be recommended for the implementation in preschool educational establishments.

DISCUSSION

The word "culture" is derived from the Latin word: culture, which means cultivation, upbringing, education, development, reverence. It is at the preschool age that we have the opportunity to begin developing the top level of movement culture. The problem of assessing the culture of movement in preschoolers has not been fully studied yet and is in its infancy. In their works, researchers Nasonova (2016), Sidovova (2002), Yeromushkina (2016), Vilevsky (1994) describe the concept of culture of movement and give possible evaluation criteria. In our study, we made an attempt to assess changes in the culture of movement in preschoolers by comparing results from two groups.

In our research study, we have introduced elements of rhythmic gymnastics in the process of physical education in preschool to develop the basis of the movement culture in children. In 6.5 months, children in the experimental group improved their indicators in all components of the culture of movements, and in the aesthetic component, and, according to the criteria, they were ahead of the children in Group 1 in motor expressiveness, emotional expressiveness and imagery ($p = 0{,}001$). In scientific and methodological literature we did not find any comprehensive information on the quantitative assessment of movement culture in preschoolers. Therefore, we can only compare the results of our study with the results of other authors for individual components. Thus, the experimental data obtained by us is a continuation of research on the level of physical and motor readiness in 5-6-year-old children. These results are consistent with the results of Maslyak, Shepel & Veretelnikova (2017), Kuzmenko & Chernysh (2018), Kasian (2017) who determined that the motor preparedness of older preschool children is at an average level. The researchers found that physical fitness resultsfor boys are better than for girls ($p < 0.05$-0.01). In our study, a significant difference between boys and girls in Groups 1 and 2 was observed in the "hand movement" with the right or left hand, "jumping in place" and "torso tilt" tests ($p < 0.05$). Testing of the technical and aesthetic components of movement culture s in preschoolers has not become widespread. In scientific works on rhythmic gymnastics training, only 7-year-old children and older are assessed for these components.

According to Kiuchukov, Yanev, Petrov, Kolimechkov, Alexandrova, Zaykova & Stoimenov (2019), rhythmic gymnastics improves all health-related components of physical fitness and has a positive effect on children's physical development.

Heinz Krombholz (2006) studied 568 children aged 37–78 months, testing them for physical development, physical skills and cognitive abilities. He found that at the start of the study, highly motor active children did better in coordination, fitness, and manual agility than average or less active children in each trial. They also did better than children with lower motor skills in concentration in each trial, and in intelligence at the end of the study. The children who lagged behind had higher body mass in each trial, and their health status was less favorable; however, the groups did not differ in body length. In our study, no such relationship was observed. It is possible that this is due to the fact that almost all of the children investigated had average or below average body mass.

The democratization of the preschool education system gave teachers the freedom to take creative initiative in

selecting programs for the physical education of preschoolers.

Cristine L. Williams, L. Kibbe, & Davide Dennison (2009) implemented Animal Trackers program in preschool institutions to increase structured physical activity (PA) during the preschool day; increase the practice of gross motor skills, and provide teachers with an easy-to-use program of physical activity regardless of their experience. After the introduction of this program, structured time of physical activity in preschool institutions has increased. According to preschool teachers, the program is suitable for children as it interests and pleases them. Studies have also shown that even a small increase in physical activity can help keep children's body mass on normal levels.

In the course of our study, we evaluated the effectiveness of well-known and positively proven tools, such as various types of gymnastics, based on theoretical and methodological provisions of kinesiological potential in human ontogenesis. The integration of selected elements of sports training into physical education has a rather deep methodological meaning. There has been a body of evidence that proves the effectiveness of rhythmic gymnastics in the development of physical and mental abilities in children and the development of culture of movements. It is also confirmed by the results of our study. The existing potential of rhythmic gymnastics and its effectiveness in the development of physical and mental abilities of children has been proven in a number of studies (Medvedeva E.N., Terekhina R.N.). However, its use in preschool physical education is still very limited.

Thus, the "Rhythmic gymnastics for preschoolers" program which includes a purpose, objectives, methods, principles, tools (exercises for general development, turns, balances, tilts, jumping, acrobatic exercises, dance movements performed without apparatus, with a skipping rope, a hoop, a ball and didactic material); musical accompaniment; class planning, a tutorial and methods of assessment, facilitates an increase in the efficiency of physical education for 5-6 year-old children and has a positive impact on all indicators of physical and motor fitness and aesthetic development of preschoolers. The program is an effective tool that helps develop preschoolers' movement culture and can be recommended for the use in preschool education institutions.

CONCLUSIONS

Our analysis of scientific and methodological literature showed that authors do not have a common view on the concept of "culture of movement" and its assessment. Their ideas are very diverse and have only philosophical conclusions. For this reason, we believe that our developed assessment model is a beginning of a new and promising direction in the theory and practice of physical education.

The introduction "Rhythmic gymnastics for preschoolers" in preschool educational institutions, aimed at developing the culture of movement in older preschool children, has a positive impact on each of its components. Our assessment of the physical component showed that in Group 2 the increase was greater in all parameters than in Group 1. A significant difference was observed in "jumping with a turn" to the right and to the left ($p < 0.05$) test. Rhythmic gymnastics positively influenced the level of development in motor preparedness of 60% of children in Group 2, and only 35% of children in Group 1.

After the experiment, indicators of the aesthetic component were significantly ($p < 0.05$) better in children of the experimental group (an increase of 16.31%) than in the control group (an increase of 5.00%, $p < 0.05$).

Thus, the introduction of the Rhythmic Gymnastics for Preschool Children program as a component of the

main program has a positive effect on the level of technical and physical preparedness of preschoolers; it helps diversify physical education in preschool institutions, and helps develop the culture of movement in 5-6year-old children.

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DESCRIPTION OF A SCHOOL SPORTS TRAINING PROGRAM FOR NOVICE GYMNASTS: THE LOAD DISTRIBUTION AND WELLBEING RESPONSES

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Abstract

The description of the training program structure and the measurement of dose-response for novice gymnasts at the scholarly level is still not elucidated in the literature. The study aimed to describe a rhythmic gymnastics training program for novices and to examine their perceptions of training load and wellbeing. Eight Brazilian gymnasts (10.6±0.5 years old), from a specific school, participated in a training program that lasted 26 weeks, and was separated into general preparation (1), specific preparation (2), intensification (3), tapering (4), competitive (5), and transitioning (6) phases. In each session, wellbeing and the internal training load (ITL) were measured by a Likert scale. The comparison of wellbeing and ITL during the program was performed by repeated-measure tests, with a significance of $p< 0.05$. A significant difference in ITL amongst the phases was found ($x^2= 110$, $p<0.001$), with Phases 3, 4, and 5 presenting higher values compared to 2 and 6. Phase 6 had lower ITL compared to 2. Higher values of wellbeing were described during the program, however, Phase 6 presented a significantly higher score compared to Phases 2 and 5 ($x^2= 12.0$, $p=0.018$). In conclusion, the rhythmic gymnastics training program developed for novice scholar participants seems to be adequate in terms of structure and training load distribution. In addition to the gymnasts reporting higher overall wellbeing during the program, attention should be paid to the competitive week, to avoid a decrease in wellbeing and possible negative effects on the gymnasts' performance.

Keywords: *Gymnast, Training load, Sport school, Extra activities.*

INTRODUCTION

The practice of rhythmic gymnastics in a scholarly context can provide benefits to the participants' motor skills, growth, development of body components (Campos-Perez et al. 2021), and also help young participants develop a motor

repertory for other sport disciplines or for practicing other physical activities. School sports are generally an optional extracurricular activity, outside the regular physical education classes, offered in some regular schools, for students to choose a specific sport they can connect with. Participating in such program can have several benefits, including enhancing physical health, cognitive function (Bradley, Keane, and Crawford 2013), motor development (Nieto 2021), and social networking (Schaefer et al. 2011), as well as preparing the participants for a potential sport specialization and the professional side of the sport.

A training program for novice participants needs to focus on learning and improving the basic movements of gymnastics, and at the same time improve the participants' performance and prepare them to be able to perform a gymnastics routine in competitions. In Brazil, the difference between school sports and professional training centers for rhythmic gymnastics is well noted. Training centers focus on *incentivizing the development and engagement of higher-performance athletes, and provide the infrastructure compatible with the athletes' needs* as described by Antualpa and Paes (2013). Gymnasts from these training centers represent the country in international competitions. However, gymnasts from training centers also compete in scholarly competitions, where also some schools are represented. It has been demonstrated recently that in the Brazilian Scholarly Games, a high percentage of rhythmic gymnasts (66.7%) were also Olympian athletes (Arantes, Rúbio, and Melo 2020).

Therefore, considering the high level of Brazilian gymnasts competing at scholarly levels, the Parana Gymnastics Federation, from Parana State in South Brazil, founded a competition called *Parana Championship for Debutants.* The state stands out in investment in training centers, and consequently achieves the best results in Brazilian competitions compared to the rest of the states in Brazil (Antualpa and Paes 2013). Thus, the debutant competition offers a fair opportunity to novice gymnasts that have never competed on any level, and is meant to be the first competition in a gymnast's career. To prepare the novice gymnast to compete in debutant categories, a training program should be well planned and should consider the participants' experience. One of the challenges faced by coaches is how to optimize the dose-response of the training load in order to increase the young gymnast's performance and minimize possible negative aspects of the sports training. Scientific literature has described the distribution of the load and the physiological and psychological responses in professional and/or elite Brazilian rhythmic gymnastics athletes' (Antualpa, Aoki & Moreira 2017, 2018; Debien et al. 2020). However, at the scholarly level, the training planning and measurements are still not well documented.

The coaches at scholarly level face some challenges, such as less time on systematic training and fewer resources. Therefore, the main aim of the present study was to describe a rhythmic gymnastics training program for novices in gymnastics, and to examine gymnasts' responses to the perception of training load and wellbeing. The study followed a theoretical background based on the previous literature to describe methodological procedures and adapted the training program to be executed in a scholarly environment for novice participants.

METHODS

Eight young female novices in rhythmic gymnastics (age=10.6±0.5 years, body mass= 38.4 ± 6.52kg, height=1.44 ±0.6m), from a private school, voluntarily agreed to participate in the study. The selected school offers extra-class sports activities for students such as futsal, basketball, handball, athletics, volleyball,

swimming, and chess. To take part in the present investigation, the following criteria were considered: i) at least one year of participation in gymnastics in the extra-class program, ii) participation in all training phases, iii) intention to compete in the Parana Championship of Debutants, and iv) ethical consent form signed before the beginning of the program. Exclusion criteria included: completed less than 75% of training sessions, or not answering the scales during the investigation. All participants met the criteria and the data from all were included in the study. The present investigation had the approval of the Ethics Committee (number 3.206.292) and written informed consent was obtained from each participant and their respective parents or guardians.

A longitudinal study was carried out during 26 weeks of planning and execution of rhythmic gymnastics training program for novice gymnasts that were focused on competing in the Parana Championship of Debutants. The training program was to be executed in phases, paying attention to the load distribution in order to achieve better performance during the championship without compromising the wellbeing of the participants. The training program was performed between the beginning of June and middle of December of 2018, separated into phases of general preparation (i), specific preparation (ii), intensification (iii), tapering (iv), competitive (v), and transitioning (vi). As the literature still lacks information about training programs for the novice or recreational gymnasts, the program was based on the traditional periodization (Mujika et al., 2018) and previous studies on Brazilian professional gymnasts (Antualpa, Aoki & Moreira 2017), and adapted to this gymnasts' group. The training program consisted of two sessions per week in Phases 1, 2, and 6, and three weekly sessions in Phases 3, 4, and 5. A wellbeing questionnaire was completed before the sessions and the rating of perceived exertion (s-RPE) was recorded afterwards.

The training program was conducted by a qualified rhythmic gymnastics coach who had 13 years training experience and a degree in physical education and a specialization in training rhythmic gymnastics.

General preparation (Phase 1). The training program started with a period of general preparation, in which the coach started by teaching the body difficulties elements that consist of three movements: jump, balance, and rotation (FIG 2018; Hashimoto et al. 2017). These movements correspond to most scores in a gymnasts' routine. The general process follows a learning progression from simple to complex movements. During this phase, the coach introduced the scales used in the study, the wellbeing scale and the rating of perceived exertion, reinforcing the importance and the purpose of each scale. This phase lasted 13 weeks and consisted of two 90-minute training sessions per week (Monday and Wednesday).

Specific preparation (Phase 2). The specific preparation phase comprised sessions with low to moderate intensity, low frequency of movements specific to the modality, and mixed training exercises such as resistance, power, flexibility, and core stability. This phase lasted four weeks (from week 14 to 17), two training sessions per week (Monday and Wednesday), 90 minutes per session.

Intensification (Phase 3). The intensification phase aimed to increase the gymnasts' workload with moderate and high intensity and an increase in specialized training. To intensify the training, the frequency and duration of the sessions were changed. This phase lasted four weeks (from week 18 to 21), with three training sessions per week (Monday, Wednesday, and Friday) each session 145 minutes long.

Tapering (Phase 4). In the tapering phase, the training volume was reduced, compared to the intensification phase, and

was focused on the execution of the gymnastics routine. This phase lasted two weeks (weeks 22 and 23) and consisted of three training sessions per week (Monday, Wednesday, and Friday), each session 115 minutes long.

Competition (Phase 5). During the competition week (week 24), the gymnasts performed three 115-minute-long training sessions (Monday, Wednesday, and Friday) that focused on the routine execution. The competition took place in a nearby city, from 30/11 to 01/12 (Friday, Saturday, and Sunday). The gymnasts competed in the afternoon (at around 1.30pm) on 30/11 (Friday), as a group in the free category (with no apparatus).

Transition (Phase 6). The transition phase, also called off-season, included exercises with low intensity to maintain the gymnasts' fitness, aimed to rest, recover and regenerate. During this phase, training sessions were longer than at the beginning of the program (Phase 1). This phase lasted two weeks (weeks 25 and 26) and consisted of two 100-minute training sessions per week (Monday and Wednesday).

Table 1
Description of the training session structure in Phase 2 to Phase 6.

Phase II – Specific preparation (from week 14 to 17)		
Training phase	Duration	Training content
Warm-up	15 min	Loading exercises, dance and ballet exercises, and flexibility exercises
Physical training	15 min	Specific training for jumps
Technical training 1	20 min	Parts of routine, including repetitions of specific event elements
Break	10 min	
Technical training 2	20 min	Routine development
Physical training	10 min	Core exercises and flexibility training
Phase III – Intensification (from week 18 to 21)		
Training phase	Duration	Training content
Warm-up	30 min	Loading exercises, dance and ballet exercises, and flexibility exercises
Physical training	30 min	Specific training for jumps
Technical training 1	30 min	Parts of routine, including repetitions of specific event elements
Break	10 min	
Technical training 2	30 min	Routine development
Physical training	15 min	Core exercises and flexibility training

Phase IV - Tapering (weeks 22 and 23)		
Training phase	Duration	Training content
Warm-up	15 min	Loading exercises, dance and ballet exercises, and flexibility exercises
Physical training	---	-------
Technical training 1	15 min	Parts of routine, including repetitions of specific event elements
Break	10 min	
Technical training 2	60 min	Routine development
Physical training	15 min	Core exercises and flexibility training
Phase V - Competition (week 24)		
Training phase	Duration	Training content
Warm-up	15 min	Loading exercises, dance and ballet exercises, and flexibility exercises
Physical training	---	-------
Technical training 1	15 min	Parts of routine, including repetitions of specific event elements
Break	10 min	
Technical training 2	60 min	Routine development
Physical training	15 min	Core exercises and flexibility training
Phase VI - Transition (weeks 25 and 26)		
Training phase	Duration	Training content
Warm-up	45 min	Loading exercises, dance and ballet exercises, and flexibility exercises
Physical training	---	-------
Technical training 1	30 min	Parts of routine, including repetitions of specific event elements
Break	10 min	
Technical training 2	---	-------
Physical training	15 min	Core exercises and flexibility training

Monitoring and managing the training load is fundamental to improving the gymnasts' performance and minimizing the risk of injury and illness, especially in the youth population. The training load was managed during the program by the

training frequency (sessions per week) and volume (time, intensity). Also, the internal training load (ITL) , which represents the stress imposed and perceived by the gymnasts, was monitored using the session rating of perceived exertion (s-RPE) multiplied by training duration (in minutes) (Foster et al., 2001). At the end of each training session, the gymnasts rated the training session intensity using the Borg CR-10 scale, adapted by Foster et al., (2001), where 1 means nothing at all, and 10 means very very hard.

The perception of wellbeing was evaluated before each training session, using a psychological scale based on the Hooper and Mackinnon (1995), and McLean et al (2010) applications. The scale consists of the evaluation of fatigue, sleep quality, general muscle soreness, stress level, and mood by a 5-point Likert scale, with scoring of 1 to 5 points. The overall wellbeing was recorded by the sum of the five scores as suggested elsewhere (McLean et al. 2010).

Statistical analysis

A descriptive analysis consisted of central tendency and dispersion measures, displayed as mean and standard deviation respectively. The comparison of ITL and wellbeing from week to week within each phase presented a non-normal distribution, therefore, a non-parametric test was performed by the Friedman test for repeated measures and dependent sample (e.g., comparison amongst the week 14 to week 26). A comparison among phases was performed by the Kruskal-Wallis test, considering that each phase presents a different number of training sessions monitored (independent groups), for example, Phase 2 = 4 weeks and Phase 4 = 2 weeks. The Bonferroni' post-hoc test was used to detect significant differences. Statistical significance was set at $p \trianglelefteq 0.5$. Data was obtained using the JAMOVI software.

RESULTS

The ITL reported by the gymnasts during the training program is displayed in Figure 1. We opted to not present the ITL reported during Phase 1 as this period was focused on the gymnast's familiarization with the scale. During Phase 2, weeks 14 and 15 presented higher values of ITL compared to weeks 16 and 17 (x^2= 11.8, p=0.008); in Phase 3; week 20 presented higher ITL compared to the rest (x^2= 29.3, p=<0.001); in Phase 4, week 23 presented higher ITL compared to week 22 (x^2= 11.8, p=0.008), and in Phase 6, week 1 was higher than week 2 (x^2= 7.0, p=0.008). To compare the ITL by phase, the weekly data was grouped under their respective phase. The Kruskal-Wallis test demonstrated a significant difference among the phases (x^2= 110, p<0.001) whereby Phases 3, 4, and 5 presented higher ITL compared to Phases 2 and 6; and Phase 6 presented lower ITL compared to Phase 2.

Overall wellbeing reported by the gymnasts during the program is displayed in Figure 2. A comparison among weeks in each phase showed that Phases 2 and 3 presented a significant variation in gymnasts' wellbeing. During Phase 2, weeks 15 and 17 presented the best values (higher scores) of global wellbeing compared to weeks 14 and 16 (x^2= 10.8, p=0.0023); in Phase 3, week 18 presented higher scores of wellbeing compared to the remaining weeks (x^2= 7.97, p=0.047). To compare the wellbeing by phase, the weekly data was grouped under their respective phase. The Kruskal-Wallis test demonstrated a significant difference among the phases (x^2= 12.0, p=0.018). Phase 6 presented higher scores of wellbeing compared to Phases 2 and 5.

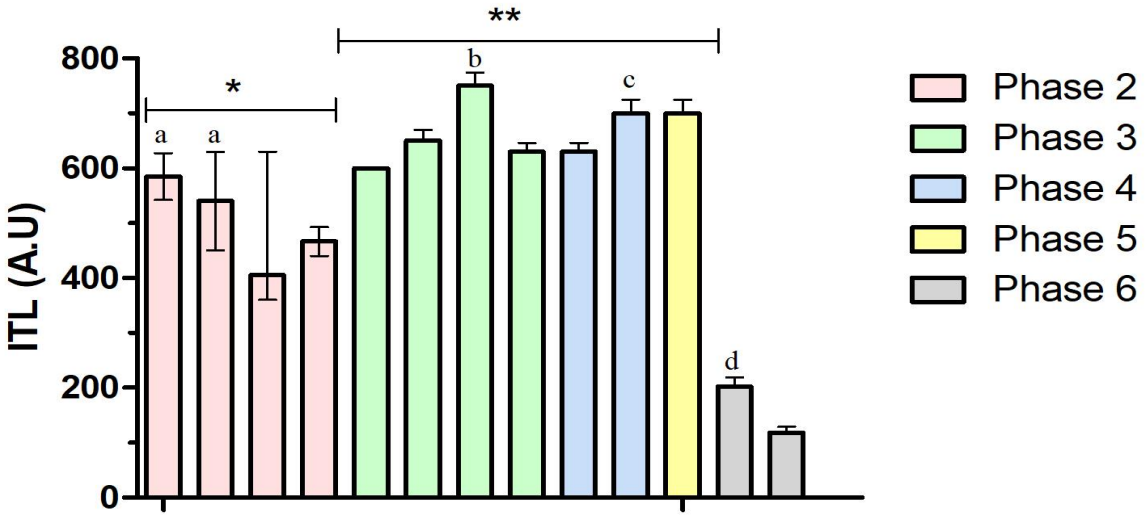

Figure 1. Internal training load during the training program.
Note: ITL: Internal training load; A.U= arbitrary unity; * higher ITL compared to Phase 6; ** higher ITL *compared to Phases 2 and 6; a= higher ITL compared to week 3 and 4; b= higher ITL compared to week 1,2 e 4; c= higher ITL compared to week 1; d= higher ITL compared to week 2. Phase 2= general preparation; Phase 3= specific preparation; Phase 4= tapering; Phase 5= competitive; Phase 6= transitioning.*

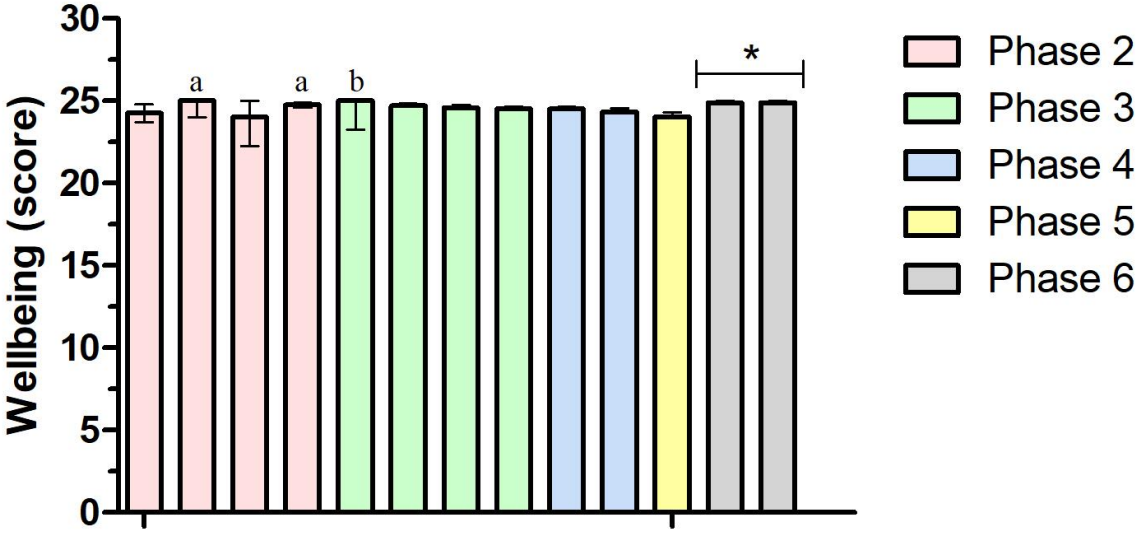

Figure 2. Wellbeing during the training program.
*Note: * higher global wellbeing compared to Phase 2 and 5; a= higher global wellbeing compared to week 1 and 3; b= higher global wellbeing compared to week 2, 3 e 4. Phase 2= general preparation; Phase 3= specific preparation; Phase 4= tapering; Phase 5= competitive; Phase 6= transitioning.*

Regarding the gymnasts' performance at the Parana Championship of Debutants, it is important to highlight that the current team was awarded second place, the silver medal. There were 11 debutant teams from schools, small clubs, and associations from the Parana State.

DISCUSSION

The main aim of this study was to develop and describe a rhythmic gymnastics training program for novices and to examine their perceptions of training load and wellbeing. The program went through different phases as well as different load distributions. It used previous studies with professional athletes (Mujika et al. 2018; Issurin 2010; Antualpa, Aoki, and Moreira 2017) as its basis, with adaptations. The results demonstrated that the gymnasts acknowledged a progressive increase in the load, from the specific training (Phase 2) to the intensification (Phase 3), and during the competition (Phase 5). This was followed by a decrease in the load during the transition period (Phase 6). In addition, the gymnasts reported higher values of global wellbeing throughout the training program, even when there was a decrease in the specific training period (Phase 2), and during the competition (phase 5).

To develop a rhythmic gymnastics training program for novices at a scholarly level, the authors based the structure of the training on a previous study with Brazilian professional gymnasts published in the literature (Antualpa, Aoki & Moreira 2017). The structure of the program was well-received by the gymnasts in this study, reflected in a variation in the ILT and higher values of wellbeing. The focus was on the preparation of the gymnasts for the Parana Championship of Debutants, where the gymnasts achieved the second place. This result leads us to assume that the program had a positive effect.

The variation in the training load plays an important role in short- and long-term training. Therefore, the present training program was planned to have a progressive increase in the load from one phase to another, with a decrease close to the competition and during the transition phase. Indeed, the gymnast perceived the load as planned in each phase, except for a decrease in the tapering period (Phase 4). At the professional level, decreased volumes are recommended prior to a competition, in order to *diminish the possible detrimental impact of training while the physiological adaptations achieved during intensive training are further enhanced* (Mujika et al. 2018). In the present training program, for the tapering phase, the weekly training frequency and session duration were lowered in comparison to the intensification phase, and the focus was on the routine presentation. Considering that the gymnasts were not professional athletes, the lower volume of training seems to positively contribute to the performance in the competition.

Interestingly, changes in ITL during the program did not affect the global wellbeing outcomes. Studies in professional athletes reported that during the higher training load periods, their wellbeing tended to decrease when compared with the tapering period (Antualpa, Aoki, and Moreira 2017; Ouergui et al. 2020). Taking into account the lower training time for novices compared to professional athletes, it is possible that the ITL was not increased enough to have an impact on the wellbeing responses of our gymnasts. The importance of monitoring the wellbeing in sports settings is to evaluate the athletes' responses to training, and also to avoid the negative effects of intense training periods. The gymnasts in the current study presented higher scores of wellbeing during the training program, as they reported values close to maximum (e.g., 25 points) in each week and phase (Figure 2). Even with a significant decrease in wellbeing during the competition (Phase 5), the values were still close to the maximum score. We speculate that those lower values for wellbeing during the competition week were due to possible stress and anxiety of the competition.

The routine and structure of scholarly devised training programs are different from the training for professional athletes. In non-professional settings, the

amount of training can vary from 2 to 3 sessions per week, requiring, therefore, a long period dedicated to the learning process. In our study, the general phase lasted13 weeks and was focused on teaching the main elements required to perform a gymnast's routine. The scientific literature also highlights the importance of the learning-training process. Tis phase is the basis of the training progress and involves the acquisition of gymnastics skills, and the process of correcting technical mistakes (Bobo-Arce and Méndez-Rial 2013). In this phase, coaches should use strategies that fit each specific gymnasts' team.

Although the study presents novel information about planning a training program for novice gymnasts, it was not without limitations. The main limitation are the selection of just one rhythmic gymnastics novice team and the small size sample. It limited the present findings to the specific team. Applying these results to different teams and conditions should be carried out with caution. Additional information could also improve our understanding of novice gymnasts' responses during a training program, including monitoring their physical and technical performance, and measurements, such as social involvement and motivation as parts of the training program. We encourage further studies to address these limitations and adapt the training program to their team.

From the practical standpoint, the study presents a training structure of a school program that could be conducted with novice gymnasts that will compete in debutant championships, and the strategies used in the present study may be applied to teams in similar conditions. Additionally, coaches and team staff are encouraged to monitor the gymnasts' ITL and wellbeing, in order to see how novices respond to the training and be able to adapt the training intensity when necessary.

CONCLUSION

The rhythmic gymnastics training program developed in the current study for novice scholar participants seems to be adequate in terms of structure and distribution of the training load. The gymnasts involved in the program posted a positive result, achieving the second place in the target competition. In addition to the gymnasts' overall wellbeing being higher during the training program, attention should be paid to the competitive week to avoid a decrease in wellbeing and possible negative effects on the gymnasts' performance.

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ANTHROPOMETRIC PROFILES OF YOUNG RHYTMIC GYMNASTIC ATHLESTES ACCORDING TO THEIR PARENTAL NUTRITIONAL BEHAVIOR

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Abstract

Rhythmic gymnastics is a sport that is supported by strength, speed and endurance with an emphasis on flexibility and coordination. It is assumed that low fat percentage, normal height, low body weight, and elegant and thin structure influence the performance of the athletes because it provides an aesthetically advantage in this sports branch. The aim of the study was to reveal the anthropometric properties in rhythmic gymnastics athletes, and to examine the changes and relationships of these parameters according to their parents' diet. A questionnaire with socio-demographic information, Parental Feeding Style Questionnaire, was used to gather data. The data on children's BMI, waist circumference and upper middle arm circumference were also included; these measurements were all taken by the same researcher. It was determined that the scores obtained from the parent feeding style scale differed according to the waist circumference of the child ($p < 0.05$). It can be concluded that the scores obtained from the parent feeding style scale and its sub-dimensions of promoting to eat /encouraging feeding and instrumental feeding differ according to the child's upper middle arm circumference ($p < 0.05$). As a result of the research, some sociodemographic and anthropometric features seem to affect the parents' feeding style of their children. The results obtained from this study can be used as a guide when creating forward-looking nutrition models for children engaged in rhythmic gymnastics, and planning the nutritional education for their parents.

Keywords: *rhythmic gymnastics, athletes. anthropometry, parental feeding style.*

INTRODUCTION

Gymnastics is defined as a sports branch that includes a high level of strength, flexibility, speed, coordination as well as muscular and cardiovascular endurance. It has positive effects on children's motor skills and self-confidence, especially in the development age (Mitchell et al., 2002). The age when children start gymnastics is lower compared to other sports branches. The main purpose of this is to emphasize the aesthetic and flexible appearance of the body and to provide basic education (Koç, 1996). Rhythmic gymnastics is a sport where flexibility and coordination are at the forefront (Jastrjembskaia & Titov, 1999). It is defined as "displaying the techniques of instruments with different features within a certain rule, in harmony with aesthetics and elegance, with free body movements, accompanied by music, and fluently" (Yayla, 2009). It seems that

low fat percentage, normal height, low body weight, elegant and thin structure have an effect on the performance of the athletes because it provides an aesthetically advantage in this sports branch (Alexander, 1991). In general, the achievement of a high level of performance and efficiency in any sport branch depends on both the hereditary abilities of the individual engaged in that sport and the skills learned for the sport (Dündar, 1996). Factors such as motor development, heredity, environmental factors, socio-economic level, intelligence and eating habits play a role in starting and maintaining sports. Children's growth rates, growth rate of their height and time to reach the maximum level, bone maturity, etc., are determined by genes. In this context, heredity becomes important in terms of gaining some skills (Özer & Özer, 2005; Toivo & Jaak, 2000). Factors such as family's attitude toward children, cultural and socioeconomic levels as the immediate environment in which children live are extremely important for the motor development of children. The results of the research conducted by Lazarou et al. show that eating habits in children are introduced by the family (Lazarou et al., 2008). For example, it is known that consuming more fatty foods in the family also causes the child to consume more fatty foods; consuming more junk food has similar effects on children (Oliveria et al., 2008).

As with all sports, nutrition plays an important role in rhythmic gymnastics. Adequate and balanced intake of all nutrients is essential for the ability to grow, develop, and maintain health, training and performance (Ersoy & Paker, 1991). The highest efficiency obtained in rhythmic gymnastics is associated with acquiring good nutritional habits and ensuring the quality of nutrition. It is known that rhythmic gymnasts tend to consume less calorie foods to keep their physical performance optimal (Benardot et al., 1989).

METHODS

The presented study was designed as descriptive and cross-sectional study. The aim of the study was to reveal the anthropometric properties in rhythmic gymnastics athletes, and to examine the changes and relationships of these parameters according to their parents' diet.

The study included 128 athletes between the ages of 6 and 16 who engage in rhythmic gymnastics as amateurs in the relevant gymnastics club, and their parents. According to the calculation results, the lowest number of samples was determined as 97. Within the scope of the study, 105 athletes and their parents were surveyed. The research was carried out between January-March 2020 in a private gymnastic sports club operating in the Anatolian Side of Istanbul.

To obtain the nutritional habits data from the participants, a questionnaire with socio-demographic information, Parental Feeding Style Questionnaire, was used. The data on children's BMI, waist circumference and upper middle arm circumference were also included in the information form and these measurements were all made by the same researcher. The body composition measures were taken before the training session started: body mass, height, and waist circumference. The protocol established by the International Society for Advancement of Kinanthropometry (Esparza, 1993) was applied for all measures. The standing height of the children was measured to the nearest 0.1 cm with a stadiometer, and their weight using an electronic scale to the nearest 50g.

We used specialised software prepared by the World Health Organisation (WHO) – 'WHO Anthro' (for children under six years of age) and 'WHO Anthro Plus' (for children over six years of age), to assess children's height, weight, and BMI (World Health Organization, 2007). For each variable we calculated the Z-

score and percentile score for the relevant age.

The Parental Feeding Style Questionnaire was developed by Wardle et al. The scale, which consists of 27 items in the 5-point Likert type, has 5 sub-dimensions, including strict control, tolerant control, emotional feeding, promoting to eat / encouraging feeding, and instrumental feeding (Wardle et al., 2002). The Turkish validity and reliability study of the scale was conducted by Özçetin et al. (Özçetin et al., 2010). The 1st, 11th, 16th and 23rd items of the scale consist of inverse questions and were inverted before the analysis. The 5th, 17th, 20th and 26th items constitute the strict control sub-dimension. The 1st, 11th, 14th, 16th and 23rd questions of the scale constitute the tolerant control sub-dimension, the 2nd, 13th, 15th, 21st and 25th items constitute the emotional feeding sub-dimension, the 3rd, 4th, 6th, 8th, 10th, 12th, 19th and 27th items constitute the promoting to eat / encouraging feeding sub-dimension and finally the 7th, 9th, 18th and 22nd items the sub-dimension of the instrumental feeding.

IBM SPSS 22 Program was used for data analysis. In order to decide on the method for data analysis, it was first checked whether the data complied with the normal distribution conditions. In the results of the Kolmogorov Smirnov Normality Test conducted in this context, the data from the Parental Feeding Style Questionnaire do not fit into the normal distribution. In this context, it was decided to use non-parametric analysis methods. The Mann Whitney U Test was used in the analysis of the difference between the two groups, and in the case of more than two groups, the Kruskal Wallis Test was used. In addition, in the case of more than two groups, Bonferonni Comparative Mann Whitney U Test was performed to find out from which group the difference originated. Finally, Pearson Correlation Analysis was conducted to analyze the relationship between child feeding behavior and their parents' feeding style. The significance level was accepted as 0.05 for all analyses.

RESULTS

The distribution of the socio-demographic data of the athletes participating in the research is given in Table 1. As can be seen, 10.5% (n = 11) of athletes are 6 and 7 years old, 32.4% (n = 34) are 8-9 years old, 30.5% (n = 32) are 10-11 years old, 17.1% (n = 18) are between 12-13 years old and 9.5% (n = 10) are between the ages of 14 and 16.

Waist and upper middle arm circumference of the athletes were measured. Data on the distribution of these values are given in Table 2. When the data on the waist circumference of the athletes are analyzed, the majority of the waist circumference (46.7% , n = 49) is between 51 and 55 cm. The proportion of athletes with a waist circumference of 61 cm and above is only 8.6% (n = 9). The average of waist circumference was 53.01 ± 6.36. Finally, the upper middle arm circumference was measured. 18.1% (n = 19) of athletes have the upper arm circumference in the range of 13 and 16 cm, this range is 17 and 20 cm for 62.9%, and 21 and 24 cm for 19% (n = 20). The upper arm circumference measurement mean was 18.41 ± 2.49 for the athletes participating in the research.

Table 1
Age distribution of athletes.

		n	%	Average
Age	6-7	11	10.5	10.14±3.32
	8-9	34	32.4	
	10-11	32	30.5	
	12-13	18	17.1	
	14+	10	9.5	

Table 2
Distribution and averages of anthropometric measurements of athletes.

	Value range	n	%	Average
Waist Circumference (cm)	35-40	2	1.9	53,01±6.36
	41-45	9	8.6	
	46-50	17	16.2	
	51-55	49	46.7	
	56-60	19	18.1	
	61+	9	8.6	
Upper Middle Arm Circumference (cm)	13-16	19	18.1	18,41±2.49
	17-20	66	62.9	
	21-24	20	19.0	

Table 3
Average of parental feeding style levels.

	n	Average	SS
Parental Feeding Style	105	73.95	9.53
Strict Controlled	105	14.41	3.31
Tolerant Control	105	16.62	2.41
Emotional Nutrition	105	7.93	3.44
Promoting to eat / encouraging feeding	105	27.80	5.75
Instrumental Feeding	105	6.10	2.74

Table 4
Average of some parameters of athletes by age.

	Age	n	Average	SS	Chi-square	p
Parental Feeding Style Questionnaire	6-7	11	3.03	0.18	11.007	0.026*
	8-9	34	2.94	0.31		
	10-11	32	2.74	0.39		
	12-13	18	2.79	0.43		
	14+	10	2.68	0.33		
Strict Controlled	6-7	11	4.06	0.80	9.840	0.043*
	8-9	34	3.7	0.61		
	10-11	32	3.35	0.92		
	12-13	18	3.63	0.89		
	14+	10	3.25	0.74		
Tolerant Control	6-7	11	3.31	0.41	1.721	0.787
	8-9	34	3.39	0.45		
	10-11	32	3.24	0.57		
	12-13	18	3.35	0,45		
	14+	10	3.30	0,38		
Emotional Nutrition	6-7	11	1.76	0.97	2.005	0.735
	8-9	34	1.56	0.60		
	10-11	32	1.66	0.71		
	12-13	18	1.37	0.57		
	14+	10	1.58	0,68		
Promoting to eat / encouraging feeding	6-7	11	3.82	0.54	8.555	0.073
	8-9	34	3.60	0.74		
	10-11	32	3.29	0.67		
	12-13	18	3.45	0.73		
	14+	10	3.25	0.81		
Instrumental Feeding	6-7	11	1.39	0.57	2.809	0.590
	8-9	34	1.62	0.73		
	10-11	32	1.58	0.76		
	12-13	18	1.38	0.55		
	14+	10	1.40	0.57		

Kruskal Wallis Test * $p<0.05$; ** $p<0.01$

Table 5
Height for age of the athletes and average of some parameters.

	Height for Age	n	Average	SS	Chi- square	p
Parental Feeding Style Questionnaire	Short	3	2.93	0.17	1.04	0.594
	Normal	89	2.82	0.37		
	Too long	13	2.93	0.30		
Strict Control	Short	3	3.50	0.66	0.33	0.848
	Normal	89	3.61	0.85		
	Too long	13	3.53	0.72		
Tolerant Control	Short	3	3.53	0.11	2.40	0.301
	Normal	89	3.33	0.51		
	Too long	13	3.23	0.21		
Emotional Nutrition	Short	3	1.86	1.02	1.34	0.510
	Normal	89	1.52	0.58		
	Too long	13	1.95	1.,08		
Promoting to eat / encouraging feeding	Short	3	3.50	0.21	1.83	0.399
	Normal	89	3.43	0.72		
	Too long	13	3.71	0.71		
Instrumental Feeding	Short	3	1,.58	0.62	0.775	0.679
	Normal	89	1.53	0.68		
	Too long	13	1.44	0.72		

Table 6
BMI for age of the athletes and the average of some parameters.

	BMİ For Age	n	Average	SS	Chi- square	p
Parental Feeding Style Questionnaire	Too weak	3	2.59	0.41	2.74	0.,433
	Weak	55	2.86	0.39		
	Normal	44	2.82	0.34		
	Fat	3	2.98	0.14		
Strict Control	Too weak	3	3.58	0.38	0.59	0.,919
	Weak	55	3.55	0.81		
	Normal	44	3.63	0.,87		
	Fat	3	3.91	0.76		
Tolerant Control	Too weak	3	3.60	0.34	4.85	0.182
	Weak	55	3.23	0.46		
	Normal	44	3.39	0.47		
	Fat	3	3.66	0.83		
Emotional Nutrition	Too weak	3	1.06	0.11	2.77	0.424
	Weak	55	1.68	0.77		
	Normal	44	1.51	0.58		
	Fat	3	1.33	0.23		
Promoting to eat / encouraging feeding	Too weak	3	2.95	1.27	2.67	0.443
	Weak	55	3.52	0.74		
	Normal	44	3.41	0.65		
	Fat	3	3.83	0.40		
Instrumental Feeding	Too weak	3	1.16	0.28	2.12	0.545
	Weak	55	1.59	0.69		
	Normal	44	1.48	0.70		
	Fat	3	1,25	0,43		

Table 7
Average of some parameters of athletes according to waist circumference measurements.

	Waist Circumference (cm)	n	Average	SS	Chi-square	p
Parental Feeding Style Questionnaire	35-40	2	3.00	0.41	11.546	0.042*
	41-45	9	3.05	0.13		
	46-50	17	2.81	0.36		
	51-55	49	2.89	0.36		
	56-60	19	2.67	0.40		
	61+	9	2.72	0.33		
Strict Controlled	35-40	2	4.12	0.17	8.607	0.126
	41-45	9	3.72	0.78		
	46-50	17	3.73	0.36		
	51-55	49	3.70	0.89		
	56-60	19	3.13	0.95		
	61+	9	3.55	0.64		
Tolerant Control	35-40	2	3.20	0.00	3.565	0.614
	41-45	9	3.22	0.,29		
	46-50	17	3.34	0.39		
	51-55	49	3.32	0.55		
	56-60	19	3,25	0.43		
	61+	9	3.55	0.51		
Emotional Nutrition	35-40	2	2.30	1.88	8.236	0.144
	41-45	9	1.93	0.76		
	46-50	17	1.37	0.73		
	51-55	49	1.57	0.59		
	56-60	19	1.70	0.74		
	61+	9	1.31	0.41		
Promoting to eat / encouraging feeding	35-40	2	3.50	0.17	10.336	0.066
	41-45	9	3.97	0.48		
	46-50	17	3.41	0.92		
	51-55	49	3.54	0.67		
	56-60	19	3.16	0.48		
	61+	9	3.33	0.95		
Instrumental Feeding	35-40	2	1.62	0.88	7.318	0.198
	41-45	9	1.44	0.58		
	46-50	17	1.55	0.72		
	51-55	49	1.58	0.68		
	56-60	19	1.59	0,81		
	61+	9	1.08	0.25		

Kruskal Wallis Test * $p<0.05$; ** $p<0.01$

Table 8
Average of some parameters of athletes according to the upper middle arm circumference.

	Arm Circumference (cm)	n	Average	SS	Chi-square	p
Parental Feeding Style Questionnaire	13-16	19	3.00	0.24	9.278	0.010*
	17-20	66	2.84	0.38		
	21-24	20	2.67	0.34		
Strict Controlled	13-16	19	3.71	0.59	2.586	0.274
	17-20	66	3.64	0.85		
	21-24	20	3.35	0.89		
Tolerant Control	13-16	19	3.20	0.29	3.388	0.184
	17-20	66	3.33	0.54		
	21-24	20	3.40	0.39		
Emotional Nutrition	13-16	19	1.84	0.94	2.708	0.258
	17-20	66	1.56	0.61		
	21-24	20	1.42	0.,59		
Promoting to eat / encouraging feeding	13-16	19	3.88	0.65	9.823	0.007*
	17-20	66	3.42	0.68		
	21-24	20	3.24	0.75		
Instrumental Feeding	13-16	19	1.53	0.69	6.224	0.045*
	17-20	66	1.60	0.72		
	21-24	20	1.23	0.44		

Kruskal Wallis Test * $p<0.05$; ** $p<0.01$

Parental feeding levels were analyzed. The averages of the scores obtained from the scales used in this context are given in Table 3. The average score obtained from the parent feeding style scale filled in by the parents was 73.95 ± 9.53. According to the results of the analysis made in terms of sub-dimensions, it was found that the parents received an average of 14.41 ± 3.31 points from the strict control sub-dimension, 16.62 ± 2.41 points from the tolerant control sub-dimension, 7.93 ± 3.44 points from the emotional feeding sub-dimension, 27.80 ± 5.75 points from the promoting to eat / encouraging feeding sub-dimension, and finally 6.10 ± 2.74 points from the instrumental feeding sub-dimension.

Our analysis of parent feeding styles according to the age of the athletes is shown in Table 4. In this context, firstly, analysis was made according to the age of the athletes. Parental feeding behavior and the scores obtained from strict control sub-dimensions, which indicate that parents used pressure in order to increase children's food consumption, were found to differ according to the age of the athlete ($p < 0.05$). According to the results of Bonferonni Comparative Mann Whitney U Test conducted to determine from which group the difference originated, the scores obtained by the parents in the 6-7 age group and 8-9 age group from the Parental Feeding Style Questionnaire were statistically significant in comparison to the scores received by the parents of other age groups. It was found that the parents in the 6-7 age group adopt the strict controlled feeding style more than the parents in other age groups; in other words, they put more pressure on their children to consume more healthy food.

It was analyzed whether nutritional behavior and parental feeding styles differ according to the height for age. The results of the Kruskal Wallis Test carried out in this context are given in Table 5. As can be

seen, the scores of athletes from the child feeding behavior scale do not differ according to the height for age ($p > 0.05$). Similarly, it was determined that the scores obtained from the parental feeding style questionnaire and its sub-dimensions did not differ according to the height for age of the child ($p > 0.05$).

We analyzed whether nutritional behavior and parental feeding styles differ according to the BMI for age value. The results of the Kruskal Wallis Test carried out in this context are given in Table 6. As can be seen, the scores obtained by the athletes from the child nutrition behavior scale do not differ according to the BMI for age ($p > 0.05$). Similarly, it was found that the scores obtained from the parental feeding style questionnaire and its sub-dimensions did not differ according to the child's BMI for age ($p > 0.05$).

It was analyzed whether the parental feeding styles differ according to the waist circumference of the child. The results of the Kruskal Wallis Test carried out in this context are given in Table 7. It was determined that the scores obtained from the parent feeding styles scale differed according to the waist circumference of the child ($p < 0.05$). However, there is no similar difference for the sub-dimensions of the scale ($p > 0.05$). According to the results of Bonferonni Comparative Mann Whitney U Test conducted to determine from which group the difference originated, the scores received by the parents of the athletes with a waist circumference between 41 and 45 cm were statistically significantly higher than the scores received by the parents of other athletes.

It was analyzed whether parental feeding styles differ according to the child's upper middle arm circumference. The results of the Kruskal Wallis Test carried out for this analysis are given in Table 8. It was concluded that the scores obtained from the parent feeding styles scale and its sub-dimensions of promoting to eat / encouraging feeding and instrumental feeding differ according to the child's upper middle arm circumference ($p < 0.05$). According to the results of the Bonferonni Mann Whitney U Test conducted to determine from which group the difference originated, the scores obtained by the parents of the children whose arm circumference was between 13-16 cm for the parent feeding style scale and its promoting to eat / encouraging feeding sub-dimensions were higher than for the other two groups. The scores obtained by the parents of children with circumference between 21-24 cm were lower than for the other two groups. In other words, promoting / encouraging eating styles, defined as parents being the nutritional role model, are used less frequently by the parents of athletes with thicker arms. Similarly, it was concluded that the instrumental feeding style, defined as providing unhealthy foods as a reward, was adopted by the parents of athletes with arm circumference of 21-24 cm more than in the other two groups.

DISCUSSION

The average BMI of athletes engaged in rhythmic gymnastics was calculated as 14.88 ± 3.27kg/m2. Similarly, as a result of the research conducted by Kankal with athletes performing rhythmic gymnastics between the ages of 9-12, it was concluded that the average BMI was 15.24 ± 0.79kg/m2 (Kankal, 2008). As a result of the study carried out by Bulca and Ersöz with the participation of 12 rhythmic gymnastics with average age of 10.1 years and engaged in active sports for 4 years, the average BMI of the athletes was calculated as 14.8 ± 1.0kg/m2 (Bulca & Ersöz, 2004). As a result of the research conducted by Sarıtaş et al. in basketball players with average age of 11.86 years, it was concluded that the average BMI of the athletes participating in the study was 20.11 ± 0.76kg/m2 (Sarıtaş et al., 2017). In a different study conducted by Ağbuba et al., the average BMI of students between

the ages of 8-12 was found to be 21.90 ± 5.35 kg/m2 (Ağbuğa et al., 2007). Within the framework of these findings, the average BMI of children who are interested in gymnastics is quite low compared to their peers who are interested in other sports or do not do sports.

It was concluded that the average waist circumference measurements of the athletes was 53.01 ± 6.36cm, and the average upper arm circumference was 18.41 ± 2.49cm for the athletes participating in the research. Similarly, the average waist circumference of students who are engaged in rhythmic gymnastics in the age range of 9-12 is calculated by Kankal as 53.43 ± 2.54cm, and the average of arm circumference is 16.82 ± 1.012cm (Kankal, 2008). Academic studies also show that individuals engaged in gymnastics have a lower body fat ratio and therefore a thinner waist and arm circumference compared to the normal population (De Bourdeaudhuij et al., 2008; Wimbush et al., 2000). In this context, it is evaluated that the findings regarding the waist and arm circumference of the athletes are compatible with the literature.

The mean score obtained from the parent feeding style scale filled in by the parents of the athletes was found to be 73.95 ± 9.53. According to the results of the analysis made in terms of sub-dimensions, it was observed that parents received 14.41 ± 3.31 points in the strict control sub-dimension, 16.62 ± 2.41 points in the tolerant control sub-dimension , 7.93 ± 3.44 points in the emotional feeding sub-dimension, 27.80 ± 5.75 points in the promoting to eat / encouraging feeding sub-dimension, and, finally, 6.10 ± 2.74 points in the instrumental feeding sub-dimension. When the related literature is analyzed, it becomes clear that there is a limited number of studies on parental feeding styles. Feeding habits of parents of children with and without attention deficit have been investigated by Yıldırım (Yıldırım, 2019). In this researchstudy, parents got 11.16 ± 3.83 points in the emotional feeding sub-dimension, 7.70 ± 2.68 points in the instrumental feeding sub-dimension, 28.97 ± 4.52 points in the promoting to eat / encouraging feeding sub-dimension, 14.45 ± 2.82 points in the strict control feeding sub-dimension, and 16.66 ± 2.08 points in the tolerant feeding sub-dimension. As a result of the research conducted by Muslu et al. on the parents of 3-6 year-old children who attend a kindergarten in İzmir province, it was observed that parents got 15.2 points in the strict control sub-dimension, 17.3 points in the tolerant control sub-dimension, 10.8 in the emotional feeding sub-dimension, 31.6 points in the encouraging feeding sub-dimension, and 8.7 points in the instrumental feeding sub-dimension (Muslu et al., 2014). When the findings are compared, it seems that the emotional and instrumental feeding styles are used less by the parents of rhythmic gymnasts than the parents of children who are not athletes, while there is no difference in terms of using strict control, tolerant control, and promoting to eat / encouraging feeding styles. It is known that "emotional feeding" behavior, which is defined as trying to calm a restless or crying child down by providing unhealthy foods, and the "instrumental feeding" behavior (Wardle et al., 2002) defined as giving unhealthy foods in exchange for consuming healthy foods, negatively affect the nutritional behavior of children in the long run (Yiğit, 2011; Savage & Birch, 2017; Heller & Mobley, 2019; Roberts et al., 2018). It seems that the fact that these feeding styles are adopted by parents of children who are interested in rhythmic gymnastics to a lesser extent compared to the general population is due to their high level of education and awareness of healthy nutrition.

It was found that the scores obtained from the strict control sub-dimensions of the parental feeding style differ according to the age of the athlete. Specifically, it was determined that the strict controlled feeding style was used more by the parents

of athletes aged 6-7 years. This situation may be due to the belief that parents should be in control of their children more because the age group in question is smaller and / or due to high sensitivity since the age group in question has just started sports. However, academic studies show that strict controlled feeding style decreases the rate at which these children consume healthy foods, such as fruits and vegetables, and increases the probability of these children becoming food addicts (Burrows et al., 2017; Blissett, 2011). This shows that it is extremely important for parents to be informed about the potential benefits and harms of athlete's nutrition and feeding styles once the child starts sports.

It was determined that parental feeding styles did not differ according to the BMI of the child but differed according to the waist circumference and upper arm circumference. When the results related to the waist circumference are examined, the scores obtained from the parental feeding styles scale decrease depending on the increase in the waist circumference of the child. This may be due to the age-related physical development of athletes, as well as a decrease in the sensitivity of the parents of older children, or a decrease of control opportunities of the parents whose children attend school. Regarding the upper arm circumference, it was observed that the promoting / encouraging feeding behavior decreased as the arm circumference thickness increased; in other words, the encouraging feeding behavior was used less by the parents of athletes with higher arm circumference. On the other hand, the instrumental feeding behavior was used less by the parents of athletes with arm circumference of 21-24 cm than the parents of athletes with thinner arm circumference. These research findings related to the upper arm circumference, which increases in proportion to the body weight, contradict the findings of the research that weak children are less encouraged to eat by their parents (Wardle et al., 2002). These findings that address the general population may not apply to athletes and their parents, and parents who are aware that success in sports is related to physical development may be more likely to encourage their children to eat if the children are weak (Wardle et al., 2002).

CONCLUSION

This study was carried out with the aim to determine the relationship between the eating behaviors of children performing amateur rhythmic gymnastics in a private gymnastic sports club operating in Istanbul province and their parents' feeding style. A total of 105 athletes between the ages of 6 and 16 and their parents participated in the study.

As a result of the research, it was determined that some sociodemographic and anthropometric features affect the parents' feeding style of their children. The distribution of data on the nutritional behavior of the athletes and parental feeding styles were analyzed and examined. The findings from this study are summarized below.

- The promoting to eat / encouraging feeding behavior are used less frequently by parents of athletes with a thicker arm circumference. Similarly, it was concluded that the instrumental feeding style was adopted more by the parents of athletes with arm circumference of 21-24 cm compared to the other two groups.
- It was concluded that the scores obtained by the parents of athletes with a waist circumference between 41 and 45 cm on the Parental Feeding Style Questionnaire were statistically significantly higher than the scores received by the parents of athletes in the other groups.
- The results obtained from this study can be used as a guide for creating forward-looking nutrition models for children doing rhythmic gymnastics and

planning the nutritional education for their parents.

- This study that deals with children engaged in rhythmic gymnastics, contributes to both local and international literature.

RECOMMENDATIONS

Recommendations arising from the results of this study are as follows:

- It is necessary to build social awareness among all adults about the responsibility and care for children who engage in sports activities through written and visual media; ,
- Counselling on nutrition and healthy development for children and their parents should be carried out by multidisciplinary teams of sports physicians, physiotherapists, athletes dieticians, sports psychologists and coaches;
- Nutritional programs of athletes should be prepared and followed by dietitians specialized in this field. Training on sports nutrition and its importance should be planned both for athletes and their families.

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ETHICS APPROVAL

This study was performed in line with the principles of the Declaration of Helsinki. Approval was granted by Istanbul Okan University, Health Sciences Research Ethics Committee with the decision no 11, dated 11/12/2019. Written consent was obtained from the participants in accordance with the principles of the Helsinki Declaration.

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BALLET IN RHYTHMIC GYMNASTICS: CONSIDERATIONS ABOUT TECHNIQUE AND INSTRUMENTATION FOR THE SPORT

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Abstract

In its historical trajectory, rhythmic gymnastics (RG) has been influenced by Swedish Gymnastics, Dance and Theatrical Arts, being today a sport characterized by a strong artistic and aesthetic appeal. Thus, starting out as field study research, this manuscript aims to bring data, but mainly reflections about the way in which classical ballet classes have been conceived and used in the training of high-performance rhythmic gymnasts. This is field research, with qualitative and quantitative approach (quanti- quali). The sample consisted of nine participants (coaches and / or ballet instructors) who work with athletes in junior and senior categories in the São Paulo State, with indexes in national championships. A questionnaire tool was conducted in the period from May 1st to 15th, 2018, in loco. Data showed that the most used ballet methods are Royal, Vaganova, French and Cuban; that the structure of the classes includes the bar and finalization, and that the planning of ballet classes is collaborative. The main goal of this practice is to learn and improve the implementation of the ballet movements in the RG Code of Points (CoP), and thus, the contents are mostly the higher valued body elements. It was concluded that there is still an accumulation of functions (coach and ballet instructor in one person), a strong influence of the CoP in the training plan of classic ballet classes, which unfortunately reinforces the great instrumentalization of this practice, disregarding its characteristics as an art, and its creative, rhythmic, aesthetic and expressive aspects.

Keywords: *Training, Classical ballet, Dance, Ballet for rhythmic gymnastics.*

INTRODUCTION

Classical ballet (CB) has been a part of rhythmic gymnastics since the artistic approach spurned the sport, after its great and initial influence by Swedish gymnastics and the movements of the time, i.e., rhythmic (Emile Jacques Dalcroze) dance (Isadora Duncan, Elizabeth Duncan and Rudolf Von Laban) and expressive elements (as Rudolf Bode performed) (Langlade & Langlade, 1970; Bobo, 1998).

Since its advent as a sports practice to the present times, RG continues to be influenced by artistic practices and dance

movements, as a folkloric connotation (Loquet, 2016; Toledo & Antualpa, 2016), or with an avant-garde connotation as modern dance (Velardi & Miranda, 2010). These influences can be identified in the attention paid to the relationship between music and movement as one of its main characteristics. Whether in the training and development of artistic skills (Mullagildina, 2016), or artistic performances delivered by the best athletes, there is a great variability of rhythms and musical styles presented by athletes in the Olympic Games (Toledo, Oliveira, Scarabelim & Assumpção, 2017). Classical ballet, as a manifestation of classical dance, continues to play a major role in RG and is a part of its Code of Points - CoP (FIG, 2021), gymnasts' routines (Furtado, Toledo, Antualpa & Carbinatto, 2020) and their training (Assis, Guiramand, Lourenço, Gaio & Lacerda, 2009), from the beginner to the top performance level (Simões & Dos Anjos, 2010; Loquet, 2016). Undoubtedly, the extensive relationship with dance has become the artistic appeal of the discipline, with greater or lesser emphasis on CoPs (Toledo & Antualpa, 2016), and differentiates it from other more athletic gymnastics branches.

However, there are different classical ballet methods. These methods were developed by ballet schools, which systematized classical ballet rules and established teaching methods following their own style. Among the best known methods are Vaganova, Royal, French, Checcetti, Cubano, Bournoville and Balanchine (Agostini, 2010).

For a better understanding of the technical, artistic and aesthetic relationship between practices, the classical ballet methods were ordered according to their name, name origin, characteristics and RG training, based on data described in the scientific literature by the following collective of authors: Sampaio (2001); Assis et al. (2009); Simões & dos Anjos (2010); Agostini (2010); Antualpa (2011) and Spalato, Toledo, Antualpa & Carbinatto (2015).

According to Agostini (2010), Whiteside & Kelly (2016) and Zeller (2017), classical ballet follows a systematization always organized into two parts: bar (training laterality), and center (training strength and balance); the bar includes stretching, flexibility, strength, agility, explosion and balance exercises, and the center includes exercises of port-de-bras (arm movements), adage (slow movements) and finally the allegros (fast or explosives movements).

In general, there is a strong emphasis in the literature on the importance of classical ballet (CB) in RG training, given the CoP demands, which creates a requirement to perform these movements (many of them even with the same names as in CB) combined with the handling of the apparatus, giving the gymnast's exercises more or less punctuation in their routines.

Certainly, this aspect is relevant, and sometimes even decisive in competitions; however, there still seems to be little appreciation of the artistic aspect of CB, considering how this practice could contribute in the expressive and creative training of the gymnast.

Thus, there is a hypothesis in this research that CB would be a practice widely used for technical purposes, although it could also be designed and used for aesthetic and artistic purposes of the discipline (expressiveness, lightness and refinement of movement), as it facilitates the construction and maturation of the technical issues related to the body elements of the CoP.. In this context, seeking to understand the motivations that bring classical ballet to training sessions in RG, this study aimed to identify the purpose, content, method and organization of CB classes in the training of high-performance gymnasts, from a local study (national) that brings reflections on the

global (international) level, and also to present an overview of how a professional who works in RG can act as a coach, an instructor, or in the dual role. In summary, this manuscript aims to bring data and reflections about the way in which classical ballet classes have been conceived and used in the training of high-performance rhythmic gymnasts.

Table 1
The classical ballet methods, their name of origin, characteristics and RG training.

Name	Name origin	Characteristics	RG training
Cecchetti	Dance master Enrico Cecchetti.	High difficulty technique, ways to develop quick thinking and structured training planning.	The Cecchetti method requires quick thinking, as it is necessary to apply speed of reasoning, mainly in the apparatus reception, connection of elements, rhythm and changes of direction during the routine
French	Gets its name after its country of origin.	Creation of the five "foot positions" and systematization of the ballet vocabulary in French.	The French method contributed the five "foot positions" that were created to facilitate agility of movements. This is of great importance to some RG elements , such as, for example, the *fouetté*, which requires agility during the execution of the turn and leg movement.
Vaganova	Student of the Imperial Ballet School of St. Petersburg, Agrippina Yarovlena Vaganova.	Fusion of French and Italian methods, divides *allegros* into two types, and strong dramatization training.	The Vaganova method connects contributions from the French and Italian methods, and its division of *allegros* helps with the technique of great jumps in RG. The method also contributed the role of dramatization with a lot of facial expression and interpretation; this artistry is recognised by the CoP and has its own score in the athletes' routines.
Cuban	Gets its name after its country of origin.	Graciousness, creativity, agility in the execution of movements;the Cuban culture inserted dynamics and rhythm in the routines.	The Cuban method contributes to the agility in the routine´s execution, develops creativity and adds refinement and lightness of movements. This method inserts some Cuban culture in dance. This characteristic has great importance for the gymnasts' routines, as it helps with the body expression, rhythm, relation to music, movement and improvisation during the routine´s execution.
Bournoville	Antoine Bournonville (1760-1843) and Auguste Bournonville - creators of the Royal Danish Theater (RDT).	Choreographies in small spaces and emphasis on male dance, high expressiveness and drama on stage.	The Bournoville method can contribute tothe performance of gymnasts' jumps as it is developed for smaller spaces. Makes use of dramatization and facial expression, which can help with the artistic criterion set by the CoP.

Balanchine	Dancer and instructor Georges Balanchine (1904-1983).	Modern ballet, composed of fast and dynamic movements.	The Balanchine method is a modern ballet, very close to contemporary dance, it contributes to body expression, and lightness and speed of movements.
Royal Academy of Dance (RAD)	Legal recognition of The Association of Operatic Dancing of Great Britain (AOD) as the Royal Academy of Dancing, and in 1991; name was changed to Royal Academy of Dance (RAD).	Evolutionary learning stages prioritizing pedagogical progression and appropriation of the level change exam (syllabus) as a strategy for disseminating the method.	The RAD method contributes to the improvements in technique and polishing of movements. However, this method produces more mechanical ballet with little expressiveness.

Characterized as field research, this is a study that "presents itself as a method of choosing and verifying data; it aims to access relevant sources, and, as such, is an integral part of heuristic research "(Sá-Silva & Guindani, 2009, p.13). There was also documentary research (Thomas, Nelson & Silverman, 2015), using the CoP (2017-2020 cycle) as the primary source and documents of the Brazilian Gymnastics Confederation (CBG) available on their website as a secondary source.

In order to select the participants, the classification of the clubs in the state of São Paulo (the state in which Lapegi is located and in which the researchers live) was previously carried out in the All-Around competition of the 2017 Brazilian Rhythmic Gymnastics Championships, in the junior and senior categories (CBG, 2017). As the inclusion criteria, we used the three best ranked clubs from São Paulo state in this championships.

For the study, we conducted interviews with RG coaches and classical ballet instructors who work with the junior and senior teams in the selected clubs. However, in two of these clubs we discovered a coach that also worked as the ballet instructor, and thus we established three professional profiles of our interviewees: RG coaches, ballet instructors, and professionals with dual role (who combine both functions). Thus, the study sample was made of 9 participants, as detailed in the table below.

The research instrument was a questionnaire, with opened and closed questions in two variants (one for coaches and one for ballet instructors). In the case of the dual role, the same professional answered both variants. The survey was conducted from 1 to 15 May 2018, *in loco*, by the main researcher of the study (first author of this manuscript).

The project was approved by the Research Ethics Committee – University of Campinas (Unicamp - CAAE: 86660518.0.0000.5404).

The questionnaire replies were analyzed using Bardin's (2011) proposal for content analysis, organized in the following way: pre-analysis, which consists of the organization of the document and aims to systematize the initial ideas; exploration of the material, which consisted of categorizing the variables chosen for the analysis in the previous phase; treatment and interpretation of the data obtained. The data were treated using a qualitative and quantitative approach (quanti-quali). This approach is widely used in studies in the humanities, as it allows for a wide understanding of the object of study and is based on the need for the sociocultural

and historical panorama (Sá-Silva & Guindani, 2009, p.13).

Table 2
Clubs and profiles of instructors and coaches.

Club	Ballet instructor	RG Coaches	Dual role (ballet Instructor and RG Coach)
Club 1	-	1	1
Club	-	1	1
Club	1	4	-
Total:	1	6	2

The qualitative data will be presented in five subdivided blocks (themes), as shown in the table below, and the quantitative data will be presented in graphical format and represented numerically.

Table 3
Data presentation structure.

BLOCK A	Profiles of classical ballet instructors and RG coaches
BLOCK B	The relationship between classical ballet instructors and RG coaches
BLOCK C	Methods used in classical ballet classes
BLOCK D	Classical ballet classes (contents and structures)
BLOCK E	Objectives of classical ballet classes in the training of RG athletes

RESULTS AND DISCUSSION

As detailed previously, the questionnaire results will be presented by thematic blocks, following the organization logic of the questionnaire itself

BLOCK A - Profiles of classical ballet instructors and RG coaches

From the 9 interviewees, two (from two of the clubs analyzed) acted in the dual role, occupying the position of ballet instructor and coach. This information can help understand the structure of classical ballet classes taught by a person who acts only as an instructor, and the structure of classes taught by a person who acts as a classical ballet instructor and a RG coach.

The the dual role is alsopresent in the composition of the technical committee of the current Brazilian RG team (cycle 2017-2021), in which the ballet instructor operates as a coach assistant and choreographer. In contrast, Antualpa (2011) pointed out that in 2010, the Brazilian RG team had a special professional working only as a ballet instructor.

This situation is also present in successful São Paulo clubs that follow the reality of the Brazilian team. Nevertheless, this mainly brings us back to the lack of investment and infrastructure in Brazilian clubs. One professional is overloaded with two functions and may perform in one role worse than in the other (the one with less professional training and experience).

Convergence of roles in high performance gymnastics training is still a reality in many Brazilian clubs, and in the national teams, as well as in other clubs and sports/gymnastics associations in other countries.

Serrão & Tricoli (2005) emphasize the need for a multidisciplinary team that acts in an integrated manner, offering support for different aspects that may influence sports performance. Nunomura & Oliveira

(2012), Schiavon, Paes, Toledo & Deutsch (2013) and Vargas & Capraro (2020) emphasize the importance of multidisciplinary teams in centers of excellence / clubs of artistic gymnastics for women and men that develop the sport both at the grassroots and at the competitive level. With regards to RG, Antualpa (2011) points out that there are professionals from different areas who provide services to the main teams in the country, and also at the training center of the

Brazilian team. However, these studies show that these multidisciplinary teams exist only in the main institutions that train athletes at the national level..

In relation to specialized training in classical ballet and experiences with ballet and ballet courses, the following data were found: 3 respondents who work as ballet instructors have a degree in physical education, one of them has specialized in classical ballet and 2 instructors have classical ballet training. Among RG coaches (6 RG coaches and 2 dual role coaches), 4 coaches have no experience with classical ballet, 1 coach practiced classical ballet as a child, 1 coach as a gymnast and 2 coaches have training and certification in CB (dual role), as shown in Figure 1.

Table 4 presents more clearly reflections on the training of these professionals involved with RG and CB. These data bring light to some reflections due to previous experience of these coaches and instructors, and also due to the training required to work in both areas.

Acting as a sports coach in Brazil, requires (except for exceptions such as fighting / martial arts and dance) a degree in Physical Education and registration in the federal council of the area (CONFEF / CREF) and is based on a Brazilian federal law (Law n. 9696, 1998). Besides this prerogative, although they are not mandatory requirements, to work as a coach in RG it is expected that professionals take complementary courses, and thus invest in continued education, aiming at professional improvement and updating.

In Brazil, such courses are mostly organized by private associations, bringing together coaches, former foreign gymnasts and/or other prominent international experts in the field. Schiavon et al. (2013) add to this discussion from the point of view of artistic gymnastics coaches by pointing out how difficult it is for coaches to acquire knowledge through courses organized by the Brazilian Gymnastics Confederation. In general, some initiatives are provided by state federations, regional leagues and private associations (Nunomura, 2001) and universities, like training coursesand/or scientific events, such as the International Forum of Gymnastics for All - “FIGPT” (Forumgpt 2021) and the International Seminar of Competitive Artistic and Rhythmic Gymnastics - “SIGARC” (Sigarc, 2021).

Specifically for CB instructors (CB only), it is noteworthy that in addition to the CB certification they also all have a physical education degree. To be a CB instructor, it is required to complete the prescribed level of education in the chosen method, but a physical education degree is not necessary. This is a gain for physical education and sport, as it was difficult to find ballet specialists with a physical fducation degree until very recently.

Despite the nonrequirement, it is expected that professionals keep themselves updated with complementary courses. In this sense, CBG (2020) recently held a series of virtual meetings with the theme "Classical Ballet Techniques for Gymnastics", taught by the Brazilian national gymnastics team’s ballet instructor and assistant coach.

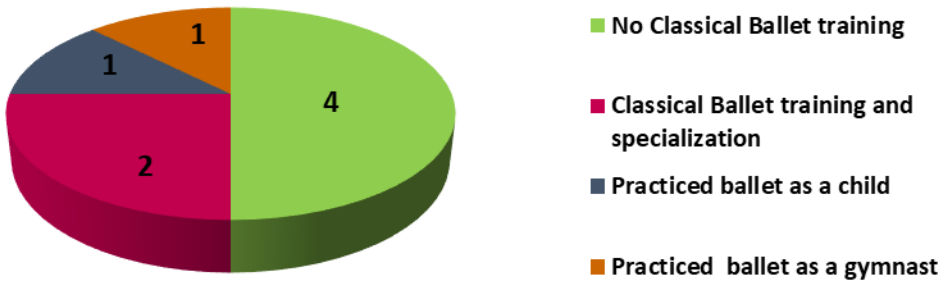

Figure 1. RG coaches education classification.

Table 4
Educational background of ballet instructors, RG coaches and those in dual roles.

Ballet instructor (1)	Dual roles (2)	RG Coaches (6)
Physical education degree Classical ballet certification	Physical education degree Classical ballet certification	Physical education degree

BLOCK B - The relationship between classical ballet instructors and RG coaches

Of the 6 coaches approached, 5 of them follow the planning process of classical ballet classes.

This large proportion of coaches involved in lesson planning is noteworthy because it provides a greater understanding of how classical ballet teaching in RG must occurs. The involvement of coaches in ballet lessons planning establishes a greater understanding between the areas (CB and RG) and improves the performance of RG athletes:

> *[...] interdisciplinarity presents itself as a methodology where the specificity of each area is respected, seeking to establish and understand the relationships between systematized knowledge, expanding the space for dialogue in the direction of negotiating ideas and accepting others. (Pontuschka, 1993, apud Weigert; Villani & Freitas, 2003, p. 4).*

BLOCK C - Methods used in Classical ballet classes

When asked about a specific classical ballet teaching methodology, two instructors said they used specific methods (Royal and Vaganova). The third instructor answered that her classes were based on the French and Cuban methodology. This response shows that some professionals adapt these methods for the RG, the gymnast and the group profile (age group, technical level, etc.). Nobody mentioned Cecchetti, Buornoville and Balanchine methods there were no answers.

The choice of the abovementioned methods was probably due to the instructors' previous exposure to them. However, this choice must go beyond the

instructors' certification; it should be based on the understanding of these methods, their conceps and theoretical and technical basis. The methods have a similar base, however, there are some characteristics that differentiate them and they can play a significant role in the athletes' successful performance of their routines.

Working with a variety of methods can bring a range of different beneifts (in relation to objectives, content, or performance), since each method has its own terminology, execution techniques, and artistic conception. The RAD method, for example, is very good for the improvement of technique, polished movements posture, but this method is relatively mechanical with little expressiveness. On the other hand, the Cuban method stimulates creativity, body expression and contributes to the artistic score in the RG CoP. The Bournoville method, adapted for limited spaces, is very strong in jumps and movements of great explosion and strength and is thus an excellent method for training jumps.

It is interesting to point out that the club with its own method developed it on the basis of two schools (French and Cuban). The club employs the movements and nomenclature of two methods; however, the structure of the classes and the teaching method are different in order to accommodate the requirements of RG.

The use of classical ballet in training sessions follows the path of using fundamentals of this practice to expand and develop gymnasts in order to improve their technical and artistic performance, even if the content developed in classes is far from the prescribed training of traditional schools. Batista, Gomes, Garganta & Ávila- Carvalho (2015) set out to investigate the training session intensity of the Brazilian team (group), and observed that the part of the session dedicated to CB is 60 minutes long, composed of bar exercises, practice of pivot fouettés (center), and ballet exercises in diagonal. This confirms the findings of this research, that classical ballet methods offer the technical-practical training and also facilitate the structuring and planning of classes, learning, and pedagogical progression.

BLOCK D - Classical ballet classes (contents and structures)

In terms of classical ballet classes structure, the following responses were obtained:

Club 1 splits the class in three sections (warm-up, bar and finalization), club 2 organizes the ballet class in four parts (bar, center, diagonal and finalization) and club 3 combines the two, splitting the classes in five sections. In other words, Figure 2 shows that “the bar” and “finishing” are sections used by all three clubs, while there is a lower use of “warm-up”, “center” and “diagonal”.

Table 5 presents the justification for the selection of one or another structure for ballet classes.

According to Sampaio (2001) and Botti & Nascimento (2011), the use of the “bar” is very important for the physical and technical preparation. This part of the class can indicate if the gymnast will be light, heavy, fast, slow and/or will be in some specific motor behavior. The authors also point out that a well worked “bar” will define the best execution of movements in other situations, i.e., if something in the execution is inaccurate, it is probably because the “bar” was not worked on efficiently and with enough time. Laffranchi (2005) compares this step to the needs of the gymnastics training, affirming that in addition to developing physical qualities, the “bar” also has the function of allowing assimilation of gymnastics postures and facilitating the execution in a conscious way. Work on the “bar” ability is fundamental for the mastery and stabilization of movement, especially for performance in the “center” (where you don't have the bar for support):

We started to dominate the bar stability. During the exercises, the body must remain upright on the leg, so that the dancer can release the hand that holds the bar, at any time, and not lose her balance. This serves as an introduction to the proper performance for core exercises. (Vaganova, 1991, apud Souza, 2012, p.76).

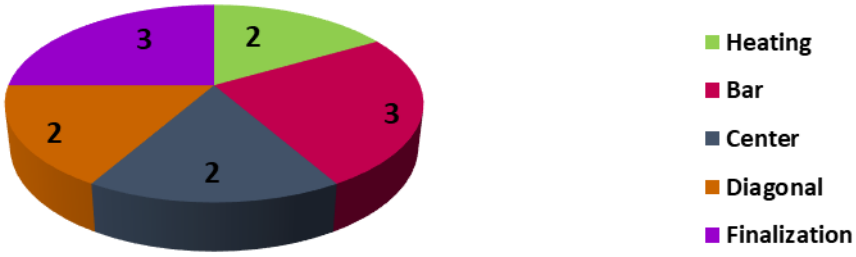

*Figure 2***.** Classical ballet classes structure by sections.

Table 5
Professional's justification.

Club – Structure	Reply (CB instructor)	Reply (RG coach)
Club 1 - Warm-up, bar and finalization	" The structure of the lesson depends on the time the athletes have for ballet classes"	"The instructor works with warm-ups and bar to improve posture, and center for conditioning and hip opening. At the end she performs jumps."
Club 2 - Bar, center, diagonal and finalization	"Because with this structure I can conduct a complete ballet training. "	"Because with this structure you get a complete workout: balance preparation, rotations and jumps, in addition to arm line and posture training."
Club 3 - Warm-up, bar, center, diagonal and finalization	"A slow start with a lot of stretching, gradually increasing the intensity, proceeding to exercises that require greater muscle strength and explosion. "	"Because with this structure you work on all points necessary for RG in a gradual increase of load (increasing difficulty of execution)."
		Three coaches did not respond.

Table 6
Contents covered in ballet class - professionals' perceptions.

Ballet instructors	RG Coaches
Motor coordination	Contemporary dance content
Improvement of gymnast's execution	Posture correction
Specific strengthening	Exercises adapted for efficiency in RG
Refinement of movements	Improvement of gymnast's execution
Posture	Strengthening and technical preparation
Correct technique to perform balances	Correct technique for the execution of balances
Correct technique to perform rotations	Correct technique to perform rotations
Correct technique for performing jumps	Correct technique to perform jumps
Grand Battement variations	Technique for expressiveness
Variations of *jeté*	Technique for refining movements
Variations of *plies*	*Grand Battement* variations
Relevance variations	Variations of *jeté*
Variations of *rond de jambé*	Variations of *plies*
Variations of *tendu*	*Relevance* variations

As for the "finalization", Agostini (2010) states that in classical ballet it should be done with *port-de-bras* exercises that are used as an educational means for lightness and communication between the arms, and serves as a gesture of appreciation at the end of class as well. The "finalization" section brings a preparation for training with small and big jumps, exercises that require greater muscular strength and explosion, i.e., exercises also considered by classical bBallet as "center" exercises.

From this perspective, it is possible to notice an approximation between RG and CB contents. In this regard, the contents of ballet classes for rhythmic gymnastics differ in two ways:

1 - Ballet contents that are part of the gymnasts' periodization, separated according to the answers of the ballet instructors and the RG coaches (Table 6);

2 - The contents proposal in the pre-competitive and post-competitive period separated according to the answers of the ballet instructors and the RG coaches (Table 7).

We identified that there are more similarities than differences between the perceptions of coaches and instructors about the contents of classical ballet that should be part of the gymnasts' periodization. Regarding similarities, professionals identify:

- posture correction;
- improvement and sharpening of the gymnastic elements similar to ballet elements (rotations, balances, jumps);
- the presence and variation of specific ballet elements, such as *plies, tendu, jeté rond de jambé*,;
- and the development of aspects related to strength.

Furtado et al. (2020), analyzed the presence of classical ballet movements in RG routines and observed that the Eastern European training model prioritizes the practice of classical ballet in its training sessions, and that this training can be noted in the performance of elements of RG, as well as in body difficulties, dynamic elements, elements with rotation, apparatus difficulties, and dance steps.

The method of developing these contents will depend on the technical choices of the instructor, and/or on what was agreed between her/him and the coach. According to Laffranchi (2005), for

example, the specific strengthening is focused on RG, where it can be performed in the center and mainly on the floor, composed of exercises, such as abdominal and plank strengthening. The center can be used as a support for posture corrections (floor), in addition to being a space that will complement training on the *barre*.

Regarding the differences between the perceptions of coaches and instructors, the ballet instructors emphasized collaboration to build up motor coordination and specific types of strength, as well as more general improvements related to the refinement of gymnast's movements. The RG coaches, on the other hand, put the emphasis on the development of expressive techniques, as well as learning contemporary dance, which, like ballet, is a type of dance and an artistic manifestation.

Our data highlight how classical ballet has been almost entirely focused on the improvement of techniques to perform elements with the CoP value (directly or indirectly). Little has been done or mentioned in relation to creativity, expressiveness, rhythm, and aesthetic appreciation.

The coaches' perspective pays attention to the use of contemporary dance contents, , highlighting that contemporary dance as a strong ally for the development of expressiveness, improvisation and dramatization of movements. Within it, it is also possible to work on other contents, such as movements, expressiveness, affectation and non-verbal communication (Stevens & MCkechnie, 2005) that are also part of the artistic component required in RG.

The organization of ballet classes, and therefore, of their content, must adapt to the gymnast's periodization established by the coach, and must vary according to the pre- and post-competitive periods. For most coaches and instructors, this differentiation seems clear, as shown in Tables 7 and 8.

Some of the contents mentioned by the ballet instructors are not described in the table, possibly because the basic elements (*tendus, pliés, relevés* and *jeté*) are commonly used in any class. When using the term "complete bar", it probably involves all types of exercises that constitute this section, such as *tendus, pliés, grand plié, relevés, jeté, rond de jambé, battement fondu, adagio, grand battement* and stretches on the bar.

Free activities appear in the post-competitive period and may be related to the gymnasts' routines, or even to activities that involve rhythm, creativity, expressiveness, and improvisation since ballet (as part of dance and the arts) allows for such exploration. This again shows how little these aspects have been explored, with a lot of scope for much more.

Floor training (exercises performed on the floor) encompass strengthening and conditioning exercises like abdominal, plank, and hollow position.

Table 7
The contents in the pre-competitive and post-competitive period mentioned by the ballet instructors.

Ballet class content in the pre competitive period: Ballet instructors	Ballet class content in the post-competitive period: Ballet instructors
Bar with basic elements	More explosive exercises
Technical training specific to RG	Muscle strength training
Elements used in the routines	Posture training
Dance to help the fluidity of movements	Complete ballet bar
Difficulties of the routines	Floor training trainingtraining
Concentration exercises	Free activities
Resistance exercises	Dance activities
Relevé exercises	
Exercises for *en dehor training*	
Complete ballet bar	
Balance training	
Small hops training in the center	

Table 8
The contents of the pre-competitive and post-competitive period asmentioned by the RG coaches.

Ballet class content in the pre-competitive period: RG coaches	Ballet class content in the post-competitive period: RG coaches
Choreographic composition	Less exercise intensity
Improvement of balances, small jumps and pivots in the routines	Correction in movement refinement
Complete bar	More loosening training
Technical training specific to RG	Dance training
Support in the sets	Waves training
Barre training in line with the routine's difficulty	More explosive exercises
Concentration exercises	Muscle strength exercises
Resistance training	Posture exercises
Relevés and en dehor training	Complete bar
Structure to fit the athletes' need to fulfill BDs (Body difficulties) in the choreographies	Teaching new techniques

Table 9
How the ballet contents are taught and grounded according to the RG coaches.

Coach	Substantiation of the content
Coach 1	It follows a **classical ballet methodology**. The instructor passes the sequence of movements logically (*pliés, tendus, rond de jambé, relevés and battements*).
Coach 2	They are based on the **Cuban and French Schools** of classical ballet.
Coach 3	They are mainly based on the **Cuban and French methods**.
Coach 4	Based on a **ballet methodology**.
Coach 5	Based on a **classical ballet methodology**.
Coach 6	They are based on a **classical ballet methodology (Vaganova**) learned by the coach in the ballet school. In stages, exercises on the floor, facing the bar, side the bar and center.
Coach 7	**Ballet methodology**.
Coach 8	They are adapted for RG. Using the **ballet base** together with the athletes'periodization.

Table 10
The contributions of classical ballet classes to the development of RG gymnasts - according to the instructors.

Ballet instructor	Reply	Category
Instructor 1 (Dual role)	"I can improve their technique to execute balances, rotations and jumps, as well as improve the posture and motor coordination ".	Improvement of the technique of body elements and coordinating aspects
Instructor 2 (Dual role)	"Ballet may be the 'boring' part of the training, because of the slow and repetitive exercises, but it helps a lot with posture, the correct arm and foot position, hip fitting; it also helps with gracefulness. Ballet techniques are the basis for most of the elements of RG. With ballet we can see an improvement in posture, agility, motor coordination, expression, and rhythm".	Improvement of the technique of body elements, artistic, coordinating and motivational aspects.
Instructor 3	"I believe that besides helping the gymnasts with rotations, balances, and jumps that are based on dance, classical ballet provides refinement and clarity of movement".	Improvement of body elements technique

Table 11

The contributions of Classical Ballet classes in the development of RG gymnasts - according to coaches.

Rhythmic Gymnastics Coach	Reply	Category
Coach 1 (Dual role)	"Because it helps in the training of posture correction , because through ballet technique, they can better execute RG difficulties. Because it helps prevent injuries due to bad posture during difficulties".	Improvement in the technique of body elements,difficulties and injury prevention.
Coach 2 (Dual role)	"Ballet may be the "boring" part of the training, because of the slow and repetitive exercises, but it helps a lot with posture, correct arm and foot position, hip fitting; it also helps with gracefulness. Ballet techniques are the basis for most of the elements of RG. With ballet we can see an improvement in posture, agility, motor coordination, expression, and rhythm".	Improvement of the technique of body elements; artistic, coordination and motivational aspects.
Coach 3	"So that they can correctly execute the body base and posture in the specific RG body elements, with increased awareness of each movement and body expression".	Improvement in the technique of body elements and artistic aspects.
Coach 4	"Classical ballet helps training the muscles the gymnast needs to jump, spin, and balance".	Muscle strengthening and improving the technique of body elements
Coach 5	"Many movements in RG have their basis in ballet. The training is based on the execution of these movements".	Improvement of the basic body elements technique
Coach 6	"The basis of RG is ballet, all our exercises are based on it. That's why ballet is so important for better execution and clean movements."	Improvement of the basic body elements technique
Coach 7	"Ballet is the basis for almost everything in RG. It is the most important thing for everything to happen."	Improvement of the basic body elements technique
Coach 8	"Ballet is the basis of RG. When ballet training is done well, athletes have fewer weaknesses in gymnas tics" .	Improvement of the basic body elements technique

Some of the contents mentioned by the ballet instructors are not described in the table, possibly because the basic elements (*tendus, pliés, relevés* and *jeté*) are commonly used in any class. When using the term "complete bar", it probably involves all types of exercises that constitute this section, such as *tendus, pliés, grand plié, relevés, jeté, rond de jambé, battement fondu, adagio, grand battement* and stretches on the bar.

Free activities appear in the post-competitive period and may be related to the gymnasts' routines, or even to activities

that involve rhythm, creativity, expressiveness, and improvisation since ballet (as part of dance and the arts) allows for such exploration. This again shows how little these aspects have been explored, with a lot of scope for much more.

Floor training (exercises performed on the floor) encompass strengthening and conditioning exercises like abdominal, plank, and hollow position.

The answers from gymnastics' coaches follow the same pattern seen in Table 7. The highlighted topic, called "teaching new techniques", shows the significance of interdisciplinary work between coaches and instructors since many of the ballet contents can help in the development of new techniques.

Tables 7 and 8 both show that the contents of the ballet classes are part of the athletes' periodization. We found some very specific contents of classical ballet, such as complete bar, *relevés* training, and *en dehor* and small jumps in the center, that are very specific to RG, such as improvement of pivots, waves and difficulties of the routines.

Table 9 shows whether the ballet content is based only on

a specific CB method or has the basis in a method borrowed from physical education.

The data presented in this table show the perceptions of RG coaches about the organization and methods used in CB classes. The coaches identified (or tried to) the method applied in the classes. Thus, we have a situation in which there is a convergence of methods in some clubs (especially those with the dual role profile); a divergence where the instructors and coaches use different methods, and the third possibility where the coaches and the ballet instructors create their own methods.

The data represents a general conception about the teaching methods and in a way validates the answers given in blocks C and D.

BLOCK E - The objective of classical ballet classes for RG athletes

Finally, Tables 10 and 11 bring answers of the ballet instructors and the RG coaches to the question in what way classical ballet classes contribute to the training of RG gymnasts.

Table 10 shows instructors' reports. Instructor 1 and 3 state that the goal of ballet classes is to improve the gymnast's technique. Instructor 2 mentions that it also aims to improve the technique and gracefulness in the elements. Table

11 brings coaches reports. In support of ballet instructors (Coach 1 and 2 act in the dual role), Coaches 5, 6, 7 and 8 also believe that the ballet classes objective is to improve the gymnasts' technique. Coach 4 considers muscle strengthening to improve technique as an objective and coach 3 emphasizes technique improvement in the first place, followed bybody awareness and expression.

For all the professionals involved in this research there is a consensus that ballet classes are used to improve elements technique, whether they are basic or difficult. For a minority of coaches and instructors, ballet can also bring improvements in other aspects, such as motivation, gracefulness, body consciousness, and expressiveness (artistic component).

The term "artistic" did not appear in the answers, but similar terms, such as "expression" and "gracefulness" appeared in the discourse. Toledo & Antualpa (2016) point out that the artistic aspect is adjusted in the scoring code every cycle, , but it was in the Rhythmic Gymnastics CoP (2013-2016) where artistic aspects were included in the judgment of routines The authors also highlight that an increased appreciation of artistic aspects goes to the roots of RG:.

> *[...] In RG, development increases the role of the aesthetic component. We can consider the aesthetic principle*

> *of rhythmic gymnastics not only as a complementary element, but as a basic element of discipline structure that directly affects the formation of sports results. Sports technique and perfection constitute, to a considerable degree, the realization of the aesthetic program. The aesthetic value of the movements must be an object of special concern to the coach and athlete (Toledo & Antualpa, 2016, p.129, apud Lisitskaya, 1995)*

Still on the purpose of ballet classes in RG gymnasts' development, we can observe a great importance of this practice for the execution, refinement, body consciousness, body expression and strength training. Antualpa (2011) and Batista et al. (2015) point out that the practice of ballet in RG allows for a posture correction, elements of flexibility, balance and rotations - in addition to other motor skills - that are fundamental to the sport. Gantcheva, Borysova & Kovalenko (2021) argue that the artistic aspect should be present in the planning of classes already in childhood..

Regarding ballet, Ribeiro (2010, p. 180) justifies that:

> *[...] because it is an ancient culture, its importance is also related to the fact that RG is based on the movements of Ballet in its Code and has been influenced by dance in its origin in a non-competitive way.*

Thus, ballet is considered the structural basis for the performance of gymnasts. The presented answers clearly show that gymnasts's weaknesses in the execution of the elements can be corrected through the practice of ballet as it trains their body awareness and specific movements.

CONCLUSIONS

The results of the present research show that the contents delivered in classical ballet classes in RG training are taught and grounded in specific ballet methods or combinations of them (Vaganova, Royal, French and Cuban). However, RG classes do not follow the classical ballet methodology faithfully; instead, their content and teaching methods are adapted to the demands of RG and the RG Code of Points. One of the coaches noticed that these classes are used to a larger extent to improve the technique of execution of the difficulties and to teach elements listed in the CoP, rather than for body training, and refinement and clarity of movements.

There is a very important emphasis in the structuring of classes, in which the bar and finalization parts dominate in all class structures described by each club.

This occurs because they are the two most important parts in training RG elements, such as body consciousness, balance, flexibility, and strengthening of muscles, in which most RG elements are based. Both parts are more related to the CoP and linked to performance and training of RG, and not to facilitate the development of artistic components.

When we think of ballet instructors and RG coaches, we believe that their goals are different because they have very different professional qualifications. It is common to find ballet instructors with only a classical ballet qualification, and coaches with a physical education degree. However, our study showed that the goals of the ballet classes are very much aligned with the athletes' RG training. This is because the ballet instructors in the three clubs are proficient in a CB method while also holding a physical education degree. This shows the importance of cooperation between instructors and coaches, and how physical education helps in better understanding and aligning the objectives between them.

Looking at ballet as a type of dance (and art), ballet classes should go beyond teaching the elements listed in the CoP. Ballet as an art should teach athletes the relationship between music, movement, expressiveness, musicality, development of body and facial expression, concentration, lightness, interpretation, and improvisation, so that athletes could be more creative in their compositions and explore ballet to help them improve their RG performance.

In this way, the question remains as to whether the instructors and trainers in RG are concerned and look at these issues that go beyond the CoP.

It can also be concluded that coaches and instructors are still very concerned with the use of ballet to improve the movement execution in order to get a higher score for the routines. More attention should be paid to how classical ballet is used since it can also contribute to other aspects related to the artistic component of RG. Also, instructors and trainers should be reminded that ballet has seven methods that should be further explored., It is impossible to state which method is the best for RG trainingas each has features that could be helpful if applied to the training of the discipline.

Finally, we believe this study is extremely important for the area even though the number of participants in the research is low. Such data and qualitative values are important to start a discussion and bring reflections on the use of ballet as a tool that can go beyond the technical objective of the modality, and the role of the professional who works in it. Furthermore, since there are no other studies of this kind, it might contribute to an improvement in the sport performance and classical ballet classes used in RG.

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CONSTRUCTION OF A SPECIFIC TEST FOR ESTIMATING COORDINATION IN RHYTHMIC GYMNASTICS

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Abstract

Rhythmic gymnastics is a combination of sport and art in which the ability of coordination plays a very important role. Since there are not enough specific tests that would assess coordination, both in the selection of children for potential rhythmic gymnasts, as well as in monitoring the training process, the main purpose of this paper is to construct a coordination assessment test that will be applied specifically to rhythmic gymnastics. The sample consisted of 93 students of the 3rd year of integrated undergraduate and graduate study at the Faculty of Kinesiology, University of Zagreb (average age 21 ± 1 year). In addition to the newly constructed test "Echappe" with the rope (MKEV), three other tests were used: ground maneuverability (MAGONT), the jumping hoop forward (MKOOPO), and the back polygon (MREPOL). Microsoft Excel 365 was used to facilitate data preparation and visualization, while IBM SPSS Statistics 26 was used for statistical analysis, with arithmetic mean and standard deviation as descriptive indicators, Shapiro-Wilks test to determine distribution normality, Kruskal-Wallis test with Bonferroni correction for validation, and Fleiss Kappa for reliability determination, which was further determined by Spearman's Rank correlation. The results showed that there is no evidence that "Echappe" with the rope measures the coordination required for success in rhythmic gymnastics, and that further research is needed with redefined criteria that will contribute to the improvement of metric characteristics of the test.

Keywords: *Motor intelligence, Newly constructed test, Metric characteristics, Rhythmic gymnastics, Coordination, "Echappe"* **.**

INTRODUCTION

Under the great influence of ballet and modern dance, rhythmic gymnastics is a connection of sport and art. Performing an exercise with music, as individual or group practitioners, the rhythmic gymnasts amaze the audience with their astonishing skills by performing extremely difficult elements with a small hand apparatus: a hoop, a ball, clubs, a ribbon and a rope. Flexibility and music interpretation are important components of rhythmic gymnastics. Coordination is considered a qualitative motor ability. Motor skills influence the efficiency of human movement. Various studies have shown that motor skills cannot be widely defined by just one, universal feature. To analyze the ability of humans to move, it is necessary to divide movements into several quantitative (strength, speed, endurance, mobility) and qualitative (coordination, balance, agility, precision) motor skills. (Cvenić, 2007). Coordination is, according to Metikoš and Hošek (1972),

the ability to control movements of the whole or part of the body. It manifests as efficient and precise execution of complex motor tasks, i.e., a quick solution of motor problems. For that reason, this ability is also called "motor intelligence". The term "coordination" refers to the precise and coordinated movement of the whole body, coordination of complex movements of the upper and lower extremities, as well as rapid motor learning, and rhythmic performance of motor tasks. Furthermore, there are several action factors of coordination. These are: speed coordination (ability to efficiently and correctly execute complex motor tasks), rhythmic coordination (ability to perform more or less complex structures of movement in a given or free rhythm), fast learning of motor tasks (fast and efficient adoption of complex motor tasks), timeliness or timing (ability to assess the spatio-temporal relations of a movement and timely response in complex motor tasks), and spatio-temporal orientation (ability to accurately distinguish spatial distances and to assess and perform a given pace of movement) (Milanović, 2013). As rhythmic gymnastics is a difficult and complex sport that requires spatio-temporal coordination of body movements and apparatus manipulation, specific motor coordination is a vital part of technical preparation with a very important role and a prerequisite for learning many rhythmic techniques. However, what distinguishes a gymnast is the amount of risk that she takes by throwing a small hand apparatus a few meters in the air, often losing sight of it, while performing jumps, pirouettes or semi-acrobatic elements, and catching it (Federation Internationale de Gymnastique, 2020). This gives us an idea how important coordination is in the equation of a rhythmic gymnastics performance. This hypothesis, although only for younger age categories, is confirmed by the research study of Purenović - Ivanović T., Popović R., Stanković D. and Bubanj S. (2016) that tested 127 rhythmic gymnasts on the national and international level to determine if it was possible to predict success of rhythmic-gymnasts on the basis of their coordination skills. The same is confirmed by research of Mullagildine A. (2017), whose purpose was to determine the influence of sensorimotor coordination on the technical readiness in the performance of elements with clubs in rhythmic gymnasts aged 8-9 years. After testing and analysing 11 elements, it was concluded that the performance of basic technical elements with clubs is influenced by the following: ability to analyze the spatial-temporal characteristics of movement; differentiate one's own muscle proprioceptive sensitivity, ability to predict the next move. In a scientific paper by Furjan, G. (1990), the relationships between situational and coordination tests, and evaluation of exercises without apparatus and exercises with a hoop were determined, and the results showed that all tests had satisfactory measurable characteristics. Research by Kolarec M., Horvatin - Fučkar M. and Radaš J. (2013) focused on the connection between motor skills and performance of technical elements with a ball, and the coordination test MBKS3L (slalom with three balls) proved to be statistically significant. In their study "Coordination training of athletes who specialize in gymnastics", Tereshchenko IA, Otsupok AP, Krupneve SV et al. (2015) aimed to experimentally determine the effectiveness of a coordination training program designed for athletes who specialize in sports gymnastics. First-year students participated in the research (21 participant: 14 girls and 7 boys, aged 17-18). The obtained results showed that the realization of the program of exercises for the improvement of static-dynamic and static-kinetic stability increased the sensory-motor coordination of students. These results concluded that a new direction for certain exercises is recommended: to practice, develop and

improve static-dynamic and static-kinetic balance of the body. Coordination training of athletes specializing in gymnastics should be one of the priorities in the system of physical education and health as well as the sport itself. The problem with research is that there are not enough specific measurement instruments to evaluate coordination in rhythmic gymnastics. As coordination in the specific equation is a top priority, it is important that coaches have as large a battery of tests as possible, especially for measuring coordination in children. Another problem is that coaches often use tests that they think that measure/assess what they need (in this case coordination) without any evidence that the specific tests really measure this. The main goal of this paper is to construct a specific coordination test that will be useful to rhythmic gymnastics trainers. In this way, the test could not only facilitate assessment of coordination skills in the selection of children for potential rhythmic gymnasts in the future, it would also assess opportunities for their progress in rhythmic gymnastics and serve as a source of insight into the training process of coordination abilities.

METHODS

The sample of subjects consisted of 93 male students of the 3rd year of integrated undergraduate and graduate university studies of the Faculty of Kinesiology, University of Zagreb (average age 21±1 years). The condition for participating in the study was not attending courses in rhythmic gymnastics, and student's health, i.e., no injuries that could affect the performance of the task itself or risk worsening any student's health condition. Before conducting the study, the respondents were informed about the goals and potential risks, signed informed consent for voluntary participation in the experiment (approved by the Ethics Committee of the Faculty of Kinesiology, University of Zagreb) and were asked if they had any injuries that prevented them from participating.

Testing was carried out in the wrestling hall; a third of the large hall of the Faculty of Kinesiology, University of Zagreb, was used. Due to the current epidemiological situation with the coronavirus, an application was submitted for the use of the faculty premises before the start of testing, which was approved, and all tests were carried out in accordance with the adopted epidemiological measures at the given moment. In addition to the main measurer, testing was carried out with two assistant measurers. Three students entered the hall at a time, and invited in the next three students after completion, thus completing the measurements of each group. In addition to the newly constructed coordination test "Echappe" with the rope, three other, already verified coordination tests, were measured: jumps over the hoop forward (MKOOPO), polygon backwards (MREPOL) and agility on the ground (MAGONT).

Jumps over the hoop forward (MKOOPO)

Coordination test "Jumps over the hoop forward" was taken from the scientific paper "Construction and validation of coordination test BOSKO" by Jagić, M. and Polančec, J. (2008). Metric characteristics that were established for this test are: sensitivity, reliability and validity.

For the test to be performed correctly, an appropriate hoop size and a stopwatch are required.

Testing is carried out in an indoor area measuring 1x1 meter. In the starting position , the respondent stands and holds the hoop with both hands in front of him. At the sign "now", the subject begins to skip the hoop first with his right, then with his left foot, and tries to do as many correct jumps as possible in 20 seconds. The person conducting the test stands near the subject and counts the correctly performed skips. The task is completed when 20

seconds pass and the examiner says "stop". The examiner performs one demonstration and gives oral instructions, while there are no trial attempts or practice before the performance. For the purposes of the data analysis of this test, the arithmetic mean is calculated.

Polygon backwards (MREPOL)

For the purpose of conducting this test, the following was used: a stopwatch, an upholstered base and a Swedish crate frame, as well as a self-adhesive tape to mark the ground space.

The task is performed in an indoor or outdoor area, with a minimum dimensions of 12x3 m. First, the starting mark (straight line) of 1 meter (start mark) is marked, and in parallel with it, the finishing line (goal mark) is marked 10 meters further. 3 meters from the initial horizontal marking of the "start", the upholstered base of the Swedish crate is placed, vertically on the direction. The place where the crate should be is marked by self-adhesive tape. Six meters from the initial mark, the largest box of the crate is placed across the track so that it touches the ground with its longer side, while the location of the obstacle is also marked. (Metikoš, Hofman, Prot, Pintar, & Oreb, 1989.) The subject takes the starting position with his back to the direction of movement and his palms and feet on the ground (knees are bent and separated from the ground, with feet immediately in front of the starting line). On the signal "now", the subject walks backwards 10 meters on all fours, trying to successfully overcome each obstacle. The first obstacle is overcome by climbing, and the second by crawling. During the execution of the task, it is not allowed to turn one's head and look in the direction of movement. The task is repeated 3 times; between repetitions, the subjects has a short break. The task is completed when the subject crosses the goal mark with both hands. During the performance of the task, the person in charge of measuring the time moves alongside the subject, holding a stopwatch in his hand and controlling the performance of the task. The elapsed time is measured and recorded in tenths of a second from the sign "now" to crossing both hands over the goal mark. In the case that the subject knocks down an obstacle, he must continue, and the crate frame is put back in its position by the examiner for the next respondent. After the examiner has demonstrated and described the task, the subjects start with the execution without a trial attempt.

Agility on the ground (MAGONT)

The props needed to carry out the test include: a stopwatch, four mats and the upper part of the judo kimono, which is duly rolled up and tied with a belt.

The subject performs the task in an indoor or outdoor space that measures at least 8x4 meters. The mats are placed in the form of the letter "L", in such a way that three mats are placed longitudinally, one after another, while the fourth is placed vertically, next to the third mat. On the edge of the fourth mat, there is the folded kimono. (Metikoš, Hofman, Prot, Pintar, & Oreb, 1989.) The subject lies on the abdomen, fully extended arms and legs, perpendicular to the first mat. At the sign "now", the subject begins to roll over the first three mats. When the subject reaches the fourth mat with his whole body, he goes on all fours and moves backwards (four-legged) over the fourth mat to the kimono. He straddles the kimono with his knees without the help of his hands, and then, holding the kimono between his knees, returns by rolling over the fourth mat back to the third. Here the subject makes a 90° turn, so that it is with his back to the first mat, and continues the back roll to the end of the first mat while keeping the kimono between his knees. The task is completed when the subject crosses the edge of the last mat with any part of his body. In the case of the kimono falling down from between the knees, the subject must again collect it with his legs, without any help of his hands and continue the

task. During the execution, the examiner walks along the subject and controls the correct execution of the task. The task is demonstrated once, accompanied with oral instructions, and repeated four times, with breaks between repetitions. In the data analysis, the arithmetic mean of all four repetition results is used. There are no trial attempts or practice before the first attempt.

Newly constructed test "Echappe" with the rope (MKEV)

The doctoral dissertation "Evaluation and analysis of the development of motor skills in rhythmic gymnastics" by Bozanic A. (2011) mentions the test of coordination with the rope "Ejecting one end of the rope (VB)," which has been modified for the purposes of this testing and called "Echappe" with the rope.

For the proper performance, ropes of different lengths are needed so that each subject performs the task in the same conditions. The rope is of good length when the subject with both legs fits in the middle of the rope holding knots in his hands and the knots are reaching to the armpits of the subject.

The subject stands and holds a rope in each arm in front of the body so that each rope knot is in one hand, and the rope makes the shape of the letter "U". At the sign "now", the subject executes a large circular movement with his arms to the back: one hand leads behind the back towards the opposite side, while the other remains in the handout, diagonally left or right (depending on which hand the subject performs the movement). At the moment of the arrival of the arm behind the back to the side of the opposite flank, the arm bends and releases the knot, while the arm in the handout makes a circular motion to bring the rope knot back towards the subject. After the subject has caught the knot, he jumps over the rope with a "feline" jump (like a high skip, from foot to foot) and completes the task. The task is performed three times and is evaluated with grades from 0 to 5. The subjects' performances are monitored and evaluated by three experts in rhythmic gymnastics (former rhythmic gymnasts from the Croatian national team, two of whom are also international judges). With oral instructions, the examiner demonstrates the task three times: face to the subjects, back to the subjects, and sideways from the subject. No trial attempt or exercise is allowed before the first attempt.

Evaluation criteria

Grade 5 - Cleanly executed "Echappe" with a clean catch and a quick skip without a stop. "Cleanly executed "Echappe" and a catch" is meant to be the correct trajectory of the rope through the air without hitting the floor when pulling the rope back and a catch of the knot before jumping over

Grade 4 - Cleanly executed "Echappe" with a clean catch and skip after a short break

Grade 3 - Executed "Echappe" with a catch and skip with or without a pause

Grade 2 – Executed "Echappe" with a catch, but without successfully jumping the rope

Grade 1 - Executed "Echappe", the rope is not caught

Grade 0 - There is no "Echappe" or any visible stage of the task – the respondent did not perform a circle with his hands, the knot immediately hits the floor, etc.

Microsoft Excel 365 was used to enter, prepare, and visualize the data, while IBM SPSS Statistics 26 was used for statistical analyses.

The arithmetic mean and standard deviation were also calculated. The Shapiro-Wilks test was used to determine the normality of distribution, on the basis of which it was decided whether to use parametric or nonparametric tests in the further processing of the results. (Shapiro & Wilk, 1965)

The validity of– "Echappe" with the rope was checked with the Kruskal-Wallis

test with Bonferroni correction to determine statistically significant differences between grades (groups) and results in other coordination estimation tests. Subjects who have better grades in this test should also have statistically significantly ($p < 0.05$) better results in other tests that assess coordination (Corder & Foreman, 2009) (Bonferroni, 1936).

Test reliability – "Echappe" with the rope was checked with Fleiss' Kapp for ordinal data. The correlation between individual measurements with Spearman's Rank correlation was further established. (Fleiss, 1971) (Daniel, 1990)

RESULTS

Descriptive statistics and data distribution

Table 1 shows descriptive indicators of the entire sample, while Table 2 shows descriptive indicators by test scores – "Echappe" with the rope.

Table 1
Descriptive indicators of sample.

	Arithmetic mean ± Standard deviation (n = 93)
Age (years)	21±1
Jumps over hoop forward (n/20 sec)	21±5
Polygon backwards (sec)	7.84±1.21
Agility on the ground (sec)	13.06±1.67

Table 2
Descriptive indicators by test scores – "Echappe" with the rope.

	Test "Echappe" with the rope				
	Grade 0 (n = 12)	Grade 1 (n = 11)	Grade 2 (n = 40)	Grade 3 (n = 30)	Shapiro-Wilks p value
Age (years)	21±1	21±2	21±1	21±1	
Jumps over the hoop forward (n/20 sec)	20±4	22±5	19±5	22±5	0.013
Polygon backwards (sec)	7.79±1.14	8.21±1.63	7.83±1.05	7.73±1.30	0.127
Agility on the ground (sec)	13.94±1.93	12.68±2.01	13.10±1.40	12.797±1.73	0.020

Table 3
Comparison of the results of different tests by assessments of the test subjects - "Echappe" with the rope.

	Test "Echappe" with the rope				
	Grade 0 (n = 12)	Grade 1 (n = 11)	Grade 2 (n = 40)	Grade 3 (n = 30)	Kruskal-Wallis p value
Age (years)	21±1	21±2	21±1	21±1	
Jumps over the hoop forward (n/20 sec)	20±4	22±5	19±5	22±5	0.046
Polygon backwards (sec)	7.79±1.14	8.21±1.63	7.83±1.05	7.73±1.30	0.601
Agility on the ground (sec)	13.94±1.93	12.68±2.01	13.10±1.40	12.797±1.73	0.248

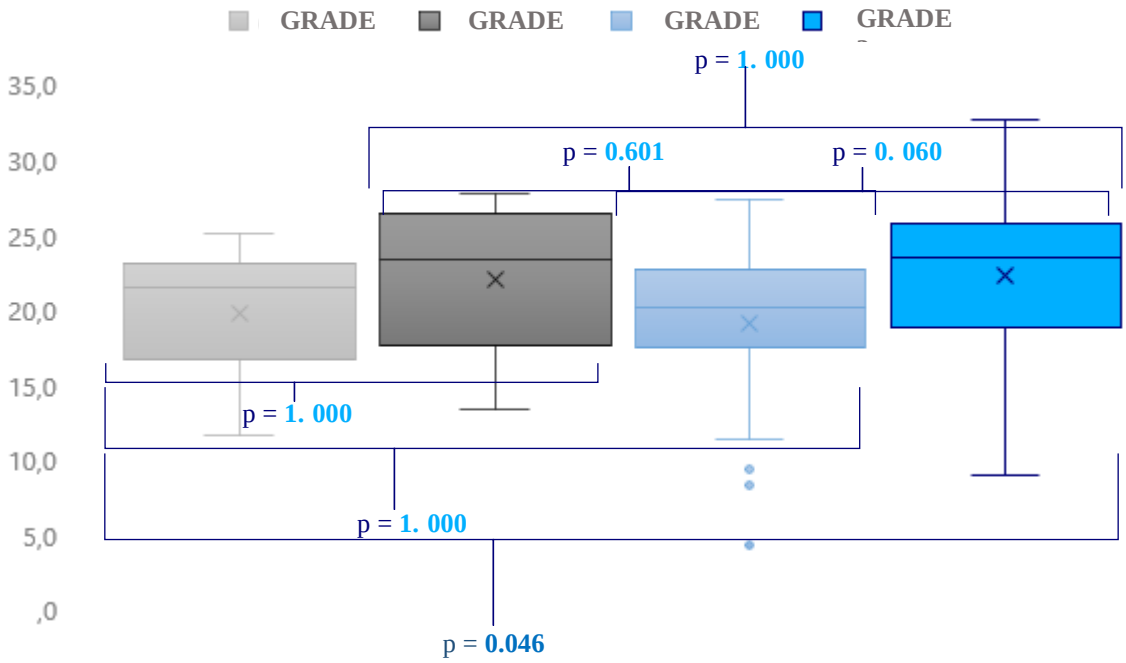

Figure 1. Comparison of test results – jumps over the hoop forward according to the test subjects' ratings - "Echappe" with the rope.

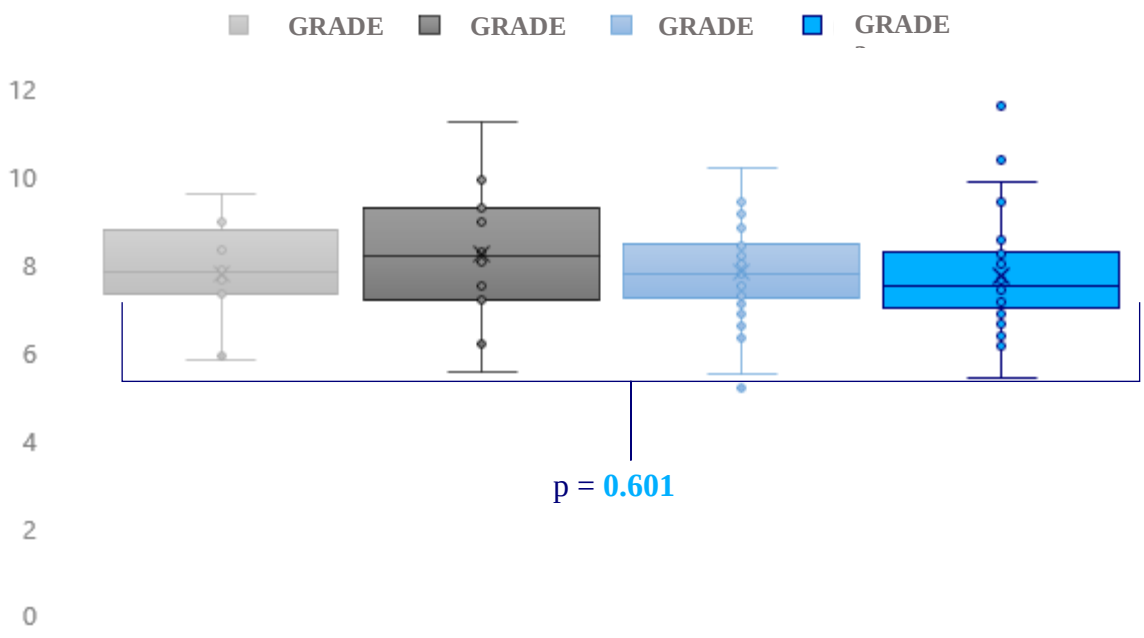

Figure 2. Comparison of test results - polygon backwards according to the assessments of the subjects in the test - "Echappe" with the rope

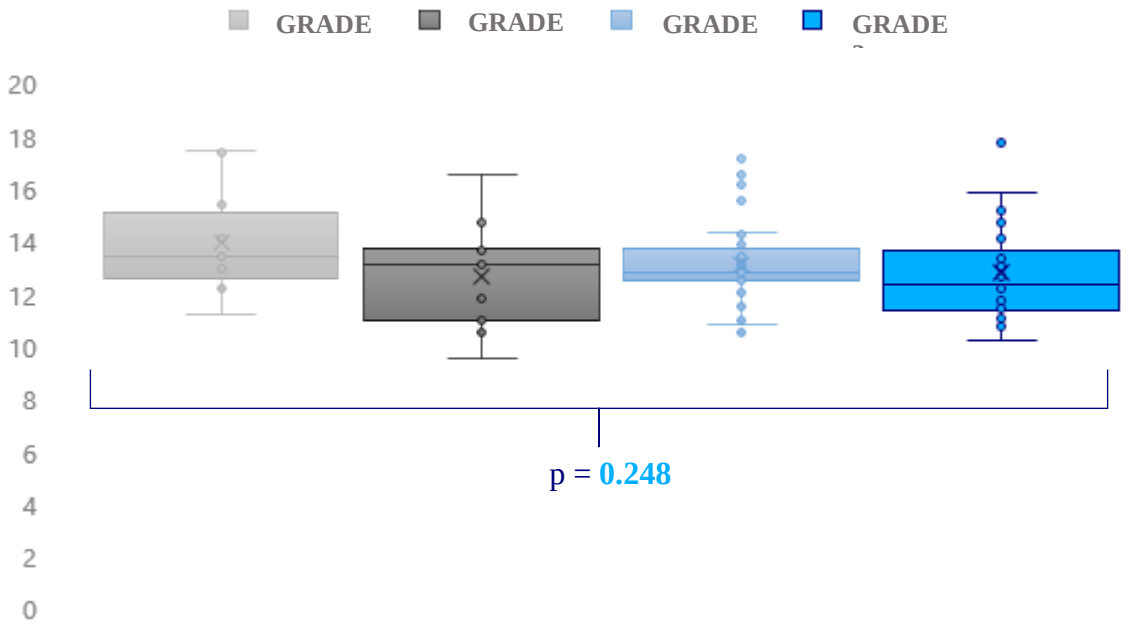

Figure 3. Comparison of test results - agility on the ground by test subjects' ratings - "Echappe" with the rope

Table 4
Connectivity and reliability of individual test measurements - "Echappe" with the rope.

Spearman correlation	Test – "Escape" with the rope			Reliability	
	1st measurement	2nd measurement	3rd measurement	Fleiss Kappa	p value
				0.120	<
Measurement1	1.000	0.341	0.335		0.001
Measurement2	0.341	1.000	0.255		
Measurement3	0.335	0.255	1.000		

Arithmetic mean and standard deviation are descriptive indicators used to describe the sample of respondents. The Shapiro-Wilks test was used to determine the normality of the distribution (Shapiro & Wilk, 1965), on the basis of which it was decided whether to use parametric or nonparametric tests in the further processing of the results.

The distribution of most variables deviates statistically significantly from the normal distribution (Table 2, p value > 0.05); therefore, nonparametric variants of the tests are used in further analyses.

There is no evidence that the test measures the coordination necessary for success in rhythmic gymnastics (Table 3, Figure 1, Figure 2, Figure 3).

Although there seems to be a statistically significant difference in the scores in the test results a detailed comparison of all groups shows that it does not really exist (Figure 1)

There is a statistically significant correlation between individual measurements ($p < 0.001$), but the power of the correlation between measurements is too weak (Fleiss Kappa = 0.120) to consider this test reliable (Table 4). The expected value of the Fleiss Kappa should be above 0.810 to consider the test reliable. (Landis & Koch, 1977)

DISCUSSION

The results of this study indicate that there is no evidence that the "Echappe" test with the rope measures the coordination required to succeed in rhythmic gymnastics. A comparison of the results for all four tests show that there is seemingly a statistically significant difference, but when comparing each group with each other in more detail, it turns out that there is no statistically significant difference between them. Furthermore, when it comes to test reliability, a statistically significant correlation exists ($p<0,001$), but it is still too weak to consider this test reliable enough. According to Landis and Koch in 1977, in order to consider a test reliable, the Fleiss Kapp should have a value above 0.810, while in this test it is only 0.120. We can also see that subjects who have better grades in the "Echappe" test with the rope do not necessarily perform better in the remaining three tests, namely jumps over the hoop forward, polygon backwards and agility on the ground, as presented in Table 3, and in Figures 1, 2 and 3. Likewise, subjects who have lower grades in the "Echappe" test with the rope do not necessarily perform worse on the above tests (Table 3, Figures 1, 2 and 3). The obtained results indicate the complexity in constructing specific tests for assessment of coordination. The question arises as to why this is the case and what can be changed in order to improve the metric characteristics of the test so that it can be used to evaluate coordination in the future. One of the reasons that certainly affects the reliability of the newly constructed test is the subjectivity of the assessment. In fact, even when conducting the test on students it was already evident that the criteria were

not defined clearly enough, and their performances were often on the borderline between two grades that were then decided by the measurers on the basis of their subjective estimation of good or poor performance. This shows us that there is still much room for redefinition and a clearer set of criteria to make the assessment as objective as possible, and ultimately more reliable. Coordination is also quite complex and undefined, composed of several components, and the question is whether it can be defined as just one ability that can be measured. For this reason, it is also called "motor intelligence". If different studies from different authors are examined, each of them will have its own definition of coordination, which does not mean that they are wrong but confirms its complexity. The author of this paper believes that it would be desirable to have an even larger battery of tests created for assessment of coordination. Each such test should evaluate one of the coordination components and thus ensure a better and more reliable assessment and certainty that it really measures the component that we want to evaluate. Each test should have its own criteria based on the capability of a particular component, and once all tests are conducted and the results obtained, new criteria can be devised for the entire battery together. The results of the tests carried out could then be added together and from the common criteria for the entire battery the final assessment of coordination with all its components could be made. Such a holistic approach which looks at all components both separately and together could be much more effective than using just one test for such a complex ability.

Furthermore, it is possible that the newly constructed test was too difficult for the student population on which it was conducted. After all, it is a specific test that requires a certain level of skill to handle the rope, and it could lead to different results on another population. For this reason, the purpose of the Purenović – Ivanovic T., Popović R., Stanković D. and Bubanj S. (2016) research study was to test and/or determine whether it was possible to predict success of a rhythmic gymnastics performance on the basis of the coordination abilities of rhythmic gymnasts. 127 national and international rhythmic gymnasts were included in this study. In multiple regression analyses of specific coordination skills, a statistically significant influence on success was found only in the group of cadets and younger cadets ($p<0.018$ and $p<0.000$), with an explanation of 42% and 50% of success in RG. The regression analysis also highlighted the contribution of three independent variables (rolling the ball – younger cadets: $p=0.03$; hoop skipping – younger cadets: $p=0.03$ and the whole sample: $p=0.02$, and manipulating clubs – younger cadets: $p=0.03$ and the whole sample: $p=0.02$) in predicting the dependent variable, with a positive link between these independent and dependent variables. This research study confirmed the importance of coordination skills for success in RG, but only for younger age categories. The scientific paper by Furjan, G. (1990) defines three main objectives: determining the relationship between situational tests and coordination tests and year from an exercise without apparatus; determining the relationship between situational tests and coordination tests and year from an exercise with the hoop, and determining the relationship between situational and coordination tests. The research was conducted with participants in the first, second and third year of schools of rhythmic – sports gymnastics, with the first stage being beginner and the third the most advanced. After conducting analyses based on the observed measurement characteristics of the selected tests for this study, it can be concluded that all tests (RSETKV, RSEKSV, RSEBLP, RSESPR, MFRURC, MFRURB, MFRMOS, MKRBUB, MSLDN, MVLR, MZON, MOZ, MPIS) have satisfactory measurable characteristics. Additionally,

they are appropriate for the subjects on whom the test was performed, except for the MKRBUB test, which is not the best test to assess rhythmic abilities.

The primary objective of the Kolarec M., Horvatin – Fučkar M. and Radaš J. (2013) study was to determine whether there was a correlation between motor skills and success in performance of technical elements in the ball exercise in rhythmic gymnastics. The study was conducted on 52 second-year students of the Faculty of Kinesiology, University of Zagreb. From the group of predictor variables, only the MBKS3L coordination assessment test (three-ball slalom) showed statistical significance in predicting success in performing selected elements.

CONCLUSION

The results of this study suggest that the newly constructed "Echappe" test with the rope is not good for estimating the specific coordination needed to succeed in rhythmic gymnastics. After processing the data and comparing the tests with each other, it can be concluded that there are no statistically significant differences between them, which means that the metric characteristics of the test (validity and reliability) are not good. The obtained results point to the fact that to improve the metric characteristics of the test, a redefinition of the criteria is required, with further research, a potential construction of a larger battery of tests that will have a better defined approach for each component of coordination as an ability, and applying the test to the rhythmic sample. In addition, there is a need for a clearer definition of criteria which will make performance assessment when testing as objective as possible.

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IMPLEMENTING A PROGRESSIVE RESISTANCE TRAINING PROGRAM IN YOUTH JUNIOR OLYMPIC WOMEN'S GYMNASTICS

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Abstract

Competitive gymnasts in the Women's Junior Olympic (JO) program are highly conditioned, typically training 8-20 hours per week. Training often consists of high-repetition body-weight activities with little variability. This method of training lacks progressive resistance exercise (PRE) training, a cornerstone for muscular adaptation. To investigate the benefits of 10 weeks of PRE training, 1 day/week, on muscular strength and power in women's JO child and adolescent gymnasts. 50 females aged 7-17 years (mean 10.2±2.7 years), competing on JO levels 3-10 participated. Gymnasts in JO Levels 3 and 4 were divided into either the Control Group or the PRE group. The Control Group continued the standard non-PRE conditioning. The PRE Group underwent the prescribed PRE training. Level 5-10 gymnasts also underwent PRE training and were separately analyzed in a quasi-experimental repeated measures design. 15 exercises were completed. Tests for lower- and upper-body power included vertical leap and a modified Wingate arm-ergometer anaerobic test (Arm-WAnT). Compared to the Control Group, the PRE Group had a greater improvement in vertical power ($p=0.003$), and Arm-WAnT peak power and mean power ($p=0.044$ and 0.023), but no difference in Arm-WAnT fatigue index. Gymnasts in Levels 5 to 10 similarly improved vertical power (2224±756W to 2473±688W, $p<0.001$), Arm-WAnT peak power (80.9±30.1W to 93.2±40.6W, $p<0.001$), and mean power (62.8±23.2 to 70.1±27.3, $p<0.001$), with no change in Arm-WAnT fatigue index. 10 weeks of PRE will improve upper- and lower-body power in child and adolescent female JO gymnasts.

Keywords: *Plyometric, Athletic performance, Resistance training, Junior Olympic, Circuit training.*

INTRODUCTION

Competitive gymnasts in the USAG Women's Junior Olympic (JO) Artistic Gymnastics program are well-trained and highly conditioned. In the United States, JO gymnasts typically train 8-20 hours per week (USA Gymnastics, 2006), with greater training volumes at higher JO levels. The ever-increasing difficulty level in women's gymnastics continues to emphasize the need for improved strength. In many gyms training consists primarily of repetitions of strength-oriented gymnastics skills and high-repetition conditioning utilizing only body-weight resistance with little variability in the exercises performed. The nature of this

low-resistance, high-repetition conditioning has limited the continued improvement in the gymnasts' strength (Sands et al., 2000). This method of training lacks progressive resistance exercise (PRE) training, a cornerstone to stimulating further adaptation for specific training goals (American College of Sports Medicine (ACSM), 2009). While current training exercises are usually specific to gymnastics performance, they lack progressive overload and variation.

Despite anticipated benefits of PRE, many coaches have been hesitant to implement resistance training programs because of persistent and disproven beliefs that resistance training is dangerous for children (Faigenbaum et al., 2009; McCambridge & Stricker, 2008), may result in undesirable bulking (Sands et al., 2000) and/or loss of flexibility (O'Sullivan et al., 2012).

The goal of this study was to investigate the effects of ten weeks of progressive resistance training on upper- and lower-body muscular power in JO female gymnasts. It was our intent to utilize training methods that were available to most gyms that may not have access to traditional weight training equipment, and coaches who are generally reluctant to sacrifice gymnastics training time. This study, therefore, utilized minimal training equipment and only one day of PRE per week. We hypothesized that once weekly PRE would significantly improve upper- and lower-body muscular power after ten weeks of training compared to standard training. We further hypothesized that once weekly PRE would significantly improve the upper-body anaerobic fatigue index.

METHODS

Gymnasts were tested before and after ten weeks of training. Gymnasts in the JO Levels 3 and 4 were divided into either the Control Group or the PRE Group. The Control Group continued the standard body-weight conditioning normally prescribed by the coaches; i.e., non-PRE conditioning. They were compared to the PRE Group that underwent PRE training. The Control and PRE Groups were matched for training duration and frequency, as well as being of equivalent age and gymnastics experience (Table 1). The Control and PRE Groups were divided by scheduled practice time which differed by the days of the week on which they practiced, but their training was otherwise equivalent. Researchers coordinated with coaches and attended practices to ensure that athletes and coaches did not deviate from their assigned training groups. Gymnasts in JO Levels 5-10 completed the PRE training, acting as their own controls. These gymnasts were analyzed separately using a quasi-experimental repeated-measures design.

50 female gymnasts, aged 6-17 years, completed 10 weeks of training. Gymnasts had previously qualified for JO levels 3-10 competitive teams following USAG guidelines. Gymnasts who had an injury or physical limitation that made them unable to perform strenuous physical activity and forced them to refrain from their typical gymnastics practice were excluded. All gymnasts were part of the same team. None of the gymnasts had a history of progressive resistance exercise training, however, all gymnasts had a history of strenuous gymnastics conditioning which consisted of repetitive low-resistance, high-repetition body-weight exercises. Prior to testing, child assent and parental consent were obtained as approved by the Institutional Review Board in full accordance with the ethical standards of the Helsinki Declaration.

All gymnasts in the PRE Group trained together, completing 15 sport-specific exercises (Table 2) performed once per week during a 45-minute circuit training session. During training, gymnasts recorded the resistance, repetitions, and their perceived effort for each exercise. This information was used

to track and prescribe progressive increases in the gymnasts' training loads. The prescribed exercises trained all major muscle groups using both isotonic and plyometric exercises (Figure 1). All exercises were prescribed for 10-12 repetitions or until failure, unless otherwise indicated (Table 2). Resistance included free weights, resistance bands, and medicine balls. To ensure that athletes exercised safely and utilized proper form, all exercises were supervised by researchers and coaches at each station in the circuit.

Figure 1. Example of body-weight plyometric exercises. Plyometric Jumps Challenge. ~61in (154cm) shown.

Power testing

Upper- and lower-body power were assessed before and after 10 weeks of training. Lower-body power was assessed using a counter-movement vertical leap. Upper-body power was assessed using a Wingate-style anaerobic arm-ergometer test. Upper body fatigue index was also assessed using the arm-ergometer test. Prior to testing, all gymnasts completed their normal team warm-up routine.

Vertical Leap

Vertical leap is a valid (Leard et al., 2007) and reliable (Glencross, 1966) field test of vertical power and lower body anaerobic power (Tharp et al., 2013). Using a Vertec (JumpUSA), gymnasts jumped off two feet from a standstill using a counter-movement jump, reaching up with their self-identified dominant hand. Standing reach was measured with the gymnasts standing flat-footed and reaching as high as they were able with their dominant hand. Prior to jumping, body weight was measured, the gymnasts were given a brief tutorial, and they were allowed a submaximal practice to ensure proper form. The measured difference between the standing reach and the leaping reach indicated the vertical leap. The best of three attempts was used to calculate vertical power. Vertical power was calculated using a model specific to children and adolescents (Gomez-Bruton et al., 2017):

$$Power\ (W) = 54.2 * VJH(cm) + 34.4 * body\ mass(kg) - 1520.4$$

Anaerobic Arm-Ergometer Test

Gymnasts performed a 30-second Wingate-style anaerobic test on a mechanically-braked arm ergometer (Monarch 881e). Similar to the traditional cycle-ergometer Wingate anaerobic test (Dotan & Bar-Or, 1983), gymnasts completed a five-minute warm-up against minimal resistance, interspersed with three or four five-second sprints against progressively increasing resistance. After the warm-up, there was a one-minute rest. As the test began, gymnasts pedaled as fast as possible, initially against inertial resistance only. The prescribed resistance (3.2% to 5% BW) was added over three to five seconds, after which the 30-second timer was started. Revolutions per five-second interval were used to calculate peak power, mean power, and fatigue index as previously described (Dotan & Bar-Or, 1983).

Statistical analyses were conducted using SYSTAT 13. Data were tested for assumptions of normality and homogeneity of variance. Gymnasts were included in the final analysis if they completed at least 70% of the training sessions. To analyze the difference between the PRE Group and Control Group, change values with training were calculated and compared via independent t-test. The changes in 5-10 PRE Group from before to after training were assessed via paired t-test. α=0.05 for all tests. Values are presented as mean±SD.

Table 1
Subject Characteristics.

	Control (n=19)	PRE (n=9)	Level 5-10 PRE (n=22)
Age (yrs)	8±1.5 (6-11)	9±1.3 (7-12)	12±6.2 (8-17)
Gymnastics Experience (yrs)	2-4	3-4	3-13
Height (cm)	130±8	135±9	147±11
Weight (kg)	28±6	31±6	41±11

Age range is presented in parentheses. No significant difference between Control and PRE Groups ($p>0.05$). Gymnastics experience represents years of training with formal coaching. Gymnasts completed at least 70% of the training sessions. Values are mean±SD.

Table 2
PRE Training Exercises.

Exercise	Brief Description	Resistance
Shoulder Press	Stand on the middle of the resistance band, elbows to the side, holding the ends of the band at the shoulders, press both arms overhead to full extension	Resistance bands – adjusted length and band resistance
Single-leg Calf Raises	Stand on the edge of a platform, ankle extension through full range of motion	Handheld weights
Triceps Pops	Push-up position, elbows in, feet remain on the floor. In one movement push off the floor forcefully, quickly move hands up to stacked panel mats	Increased goal height of stacked panel mats
Back Extensions	Torso hanging from an elevated surface perpendicular to the floor, legs parallel to the floor, weight held to the chest, raise torso through full lower back extension	Handheld weights
Plyometric Jumps Low	On sprung floor, plyometric jumps forwards to series of approx. 60cm platforms, approx. 1.5 m apart	Increased speed of completion

Plyometric Jumps Challenge	On sprung floor, single plyometric jump from 24 in platform to highest achievable height	Increased goal height – stacked panel mats, table trainer
Deadlifts	Stand on the middle of the resistance band with both feet, pull on ends of the band through standard deadlift range of motion	Resistance bands – adjusted length and band resistance
2-Arm Ball Throw	Feet staggered, medicine ball held at the forehead, ball is thrown forward as far as possible, emphasizing triceps	Medicine Balls
1-leg box jumps	Single-leg jumps up (forward) and down (backward) from a stack of mats, alternating legs for each jump	Increased stack of panel mats
Pistol Squats	Single-leg squats with supporting leg to approx. 90^0, opposite leg held straight anteriorly	Handheld weights
Shoulder 3-way	While standing straight arms are abducted from the side through approx. 90^0, anterior, lateral, and posterior	Handheld weights
Plyometric Abs	Lie supine with a partner standing on either side of the head. Partner's ankles are held for support. Flexion at the hip and lower back to raise straight legs forcefully towards the standing partner. Standing partner forcefully throws straight legs back down, legs are stopped just before hitting the floor, then flexion is forcefully repeated	Partner increases force of leg throw
Star Excursion Balance	Star excursion balance exercise using an unstable surface reaching the unsupported leg anteriorly, posteromedial, and posterolateral as far as possible (Kinzey & Armstrong, 1998)	Progressively less stable surface – carpet, foam balance pad, Dynadisc
Tricep dips	Straight legs are supported at the ankle by partner, held parallel to the ground. Hands on the balance beam, bend at the elbows to approx. 90^0 to dip the torso below the top of the beam, then press upwards, focusing on elbow extension	Medicine balls held on lap
Hanging Abs	Hang from bar, quickly raise straight legs, touching toes to the bar, slowly return to full extension and repeat	Increased repetitions to failure

Exercises were performed with a partner under the supervision of researcher or coach. Exercises were performed in the same order through a circuit. The starting point of the circuit was random for each gymnast. All exercises were prescribed for 10-12 repetitions or until failure, unless otherwise indicated.

RESULTS

50 gymnasts completed at least 70% of the training sessions and were included in the final analysis, including 19 in the Control Group, nine in the PRE Group, and 22 in the Levels 5-10 PRE Group (Table 1).

Vertical Leap

The PRE Group had a significantly greater improvement in vertical power than the Control Group, increasing by 235.2±50.7 Watts and 80.1±205.4 Watts respectively ($p=0.018$) (Figure 2). Similarly, the 5-10 PRE Group significantly improved their vertical power compared to the baseline by 225.9±206.3 Watts ($p<0.001$) (Figure 2).

Anaerobic Arm-Ergometer Test

PRE training resulted in a significantly greater peak power on the anaerobic arm-ergometer test. The PRE Group increased peak power by 12.3±14.3 Watts compared to an increase of 3.2±9.1 Watts in the Control Group ($p=0.027$). Similarly, the 5-10 PRE Group increased peak power by 16.0±22.9 Watts compared to the baseline ($p=0.006$) (Figure 2). Mean power on the anaerobic arm-ergometer test also significantly increased with PRE training. The PRE Group increased mean power by 6.8±5.0 Watts compared to an increase of 2.7±3.1 Watts in the Control Group ($p=0.007$). The 5-10 PRE Group significantly increased mean power by 10.3±13.8 Watts compared to the baseline ($p=0.001$) (Figure 2). There was no significant difference in fatigue index between the PRE and Control Groups ($p=0.245$) or between timepoints for the 5-10 PRE Group ($p=0.443$). Overall, fatigue index before training was 39.1±13.3% compared to 40.2±10.5% after training.

DISCUSSION

It was the goal of this study to implement and assess a pragmatic progressive resistance exercise training program for child and adolescent female JO gymnasts. Previous published research in gymnasts has focused on older college and elite level gymnasts with access to the traditional weight training equipment and more available training time to undergo more traditional PRE training (Brooks, 2003; James, 1987; Sands et al., 2000). We demonstrated an effective PRE training program that could be completed in only 45 minutes, one day per week, using minimal training equipment. We observed significant improvement in upper- and lower-body muscular power. These results were consistent when compared to the Control Group in the lower JO levels 3 and 4, as well as within the upper JO levels 5-10.

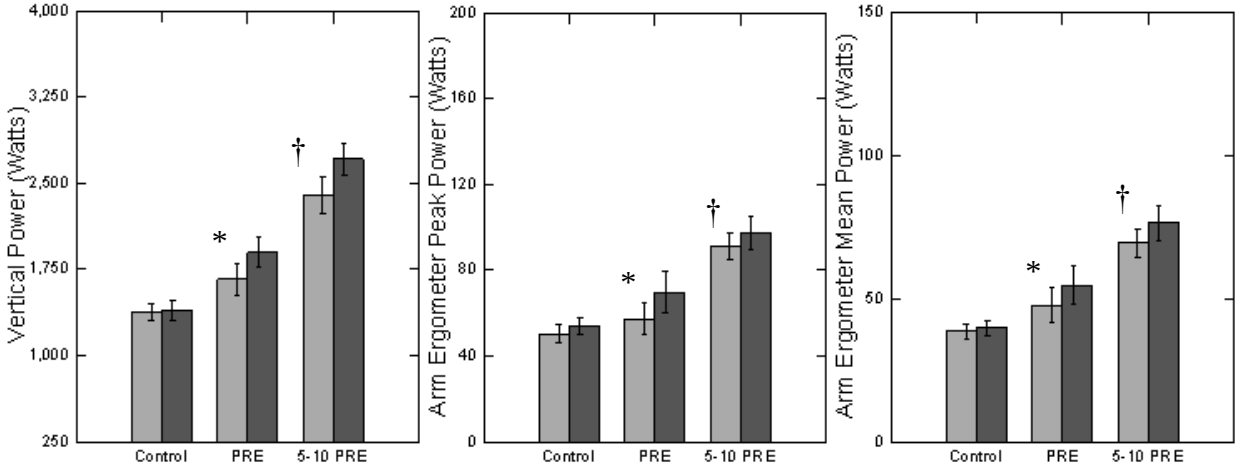

Figure 2. Changes in upper- and lower-body power with training. Bars represent values before and after training for each group. * indicates significantly greater change with training compared to the Control Group ($p<0.050$). † indicates significant change with training compared to the baseline ($p<0.050$). Not shown, there was no significant change in fatigue index with training.

The improvement in muscular power we observed in these female child and adolescent gymnasts is consistent with previous studies examining strength training in similar age groups (Akın, 2013; Dahab & McCambridge, 2009; Faigenbaum et al., 2009; McCambridge & Stricker, 2008; Myers et al., 2017). The current study was not designed to assess mechanisms of improved muscular strength or power. Previous literature indicates that in pre-pubescent children, improvements in strength are more strongly influenced by neuromuscular improvements than hypertrophy, including improved motor unit recruitment and firing rate, and motor coordination (Falk & Eliakim, 2003; Legerlotz et al., 2016; Ozmun et al., 1994). Muscle hypertrophy seen in children (Fukunaga et al., 1992) is expected to be small relative to the change in strength, and a lesser contributor to strength improvement compared to adults (Hass et al., 2001). In adolescents, we may expect greater hypertrophy compared to children; however, evidence indicates the hypertrophic response to resistance training remains less than in adults (Legerlotz et al., 2016). Coaches are often reluctant to incorporate strength training for fear of bulking of the gymnasts (Sands et al., 2000). Previous research in upper level gymnasts has actually shown that typical gymnastics strength training that consists of high repetition body weight exercises is more likely to contribute to bulking with less benefit to strength (Sands et al., 2000).Twice weekly PRE is generally accepted as the minimum to elicit significant strength gains in adults (ACSM, 2014; Dahab & McCambridge, 2009) and children (Faigenbaum et al., 2009) . While our program was only implemented once weekly, the gymnasts maintained their normal body-weight, non-progressive conditioning during regular practices on the other 2-4 days per week, depending on their JO level. These results demonstrated that the addition of once-weekly bout of PRE training provided a sufficient overload stimulus to result in significant improvement in upper- and lower-body muscular power.

CONCLUSIONS

As a sport, gymnastics requires substantial practice time and financial

investment. Therefore, this training program was designed to keep time and costs at a minimum while still providing an effective training stimulus. We effectively demonstrated that despite the high level of conditioning these athletes undergo, the addition of once-weekly PRE training can significantly improve muscular power, and thus increase their potential to improve gymnastics performance.

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QUALITY OF LIFE, LEVEL OF ANXIETY AND LEVEL OF DEPRESSION AMONG FORMER ARTISTIC GYMNASTS, FORMER GYMNASTS FROM OTHER SPORTS AND NON-ATHLETES

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Abstract

Involving people in physical activity or sport provides some health-related benefits and has a positive effect on their quality of life (QoL). However, high level athletes experience anxiety to cope with the high demands of the sport. The purpose of the study was to assess the QoL, level of anxiety (STAI) and level of depression (BDI) among former artistic gymnasts, former athletes from other gymnastics sports (acrobatic, rhythmic, gymnastics for all) and non-athletes. Secondly, it aimed to investigate if there are gender differences within the groups on the aforementioned variables. 114 healthy people (75 women and 39 men) were involved in the present study with a mean age 27.11 ± 9.92 years. The sample was divided into 3 different groups (1st group: 39 former artistic gymnasts (FAG); 2nd group: 53 former gymnasts from other gymnastic sports (GOS), and 3rd group: 22 non-athletes (CG). Participants were asked to complete three different questionnaires in order to assess their QoL, STAI, and BDI. Statistical analysis showed no significant differences on QoL and STAI, whoever a statistically significant difference was found between groups on BDI (p <.05). No main effect was found on gender. Further, results revealed that former gymnasts, regardless of the type of sport, have better QoL, lower level of STAI and BDI compared to non-athletes. In conclusion, former gymnasts, even after years of absence from the sport, report better QoL, and have a lower level of STAI and BDI than non-athletes.

Keywords: *quality of life, anxiety, depression, gymnasts.*

INTRODUCTION

Physical activity forces the human body to work harder than usual;it can take many different forms from simple gardening, housework, games, dancing, etc. (Zourikian, Jarock, Mulder, 2012). The term "physical activity" is often confused with "exercise". Exercise includes physical movements, but this form of physical activity is programmed and specially designed to be repeated in order to improve or maintain the physical condition of the individual (Zourikian et al., 2012; World Health Organization, 2019). Physical exercise has beneficial effects on health, both physically and mentally (Cevada, Cerqueira, Moraes, Santos, Pompeu, and Deslandes, 2012), and a positive effect on anxiety; whereas lack of exercise can have negative effects on human health and well-being (Ströhle, 2008), increasing the risk of various diseases such as diabetes, obesity,

osteoporosis, and depression (Warburton, Nicol, Bredin 2006). Previous data indicate that exercise can be used as a treatment to improve a variety of conditions in physical and mental human health (Nabkasorn et al., 2005) since exercise has a positive relationship with the outcome of various mental illnesses, such as depression (Nabkasorn et al., 2005).

Former athletes, even after decades of absence from the sport, can help maintain their positive behavior (Bäckmand, Kaprio, Kujala, Sarna, 2001), have greater life satisfaction, better functional capacity, fewer depressive symptoms and a better quality of life (QoL) than non-athletes (Bäckmand et al., 2001). Although athletes experience a lot of anxiety in relation to their performance during their sporting careers, research shows that decades after quitting, their anxiety level is lower than in their peers who were not involved in sports in the past (Bäckmand, Kaprio, Kujala, Sarna, 2009; Cevada et al., 2012). In addition, it is well documented that athletes on artistic gymnastics (AG) have higher levels of stress during their careers (Bäckmand et al., 2001) and the countless hours of training in order to stand out in the sport may create a greater perception of stress and increased cortisol levels (Cevada et al., 2012).

The term "quality of life" (QoL) is a multidimensional concept and was first used in America after World War II to indicate that it is not only identified with the standard of living but also with a good life in the sense of leisure and entertainment (Campbell, 1981). Clinicians examine the physical aspects of the term, while psychologists focus on the emotional and cognitive dimensions of health (Yfantopoulos, 2001). Most definitions focus on several elements and are considered either subjective or objective or a combination of both. Previous studies (Meeberg, 1993; Tartar, Erb, Biller, Switala, van Thiel, 1988) perceived QoL as a multifaceted construct that includes reported life satisfaction, a person's sense of self-satisfaction in various areas of life, the behavioral and cognitive ability of the individual, as well as emotional well-being. Involving people in physical activity or sport provides some health-related benefits and this has a positive effect on their QoL and improves person's mood (Bäckmand et al., 2001). Snyder, Martinez, Bay, Parsons, Sauers, and McLeod (2010) reported that athletes had a higher level of QoL than non-athletes, both in mental health and in physical and social aspects. According to Filbay, Pandya, Thomas, McKay, Adams, and Arden (2019), QoL of former athletes is less understood and there is a possibility that sport has a positive or even negative effect on their later life. In general, former athletes have a better QoL than the general population: their physical function is similar but their mental function is better (Bäckmand et al., 2001; Cevada et al., 2012; Filbay et al, 2019). These findings show that previous competitive athletic experience can help improve athelets' QoL even after a long withdrawal period from sport, as it is associated with improved physical and mental aspects (Bäckmand et al., 2001).

Anxiety arises when individuals realize that they cannot adequately cope with the demands placed on them (Lazarus and Folkman, 1984). People with anxiety can experience both physical and psychological symptoms that can affect their daily lives (Johnston, Roskowski, He, Kong, and Chen, 2020). Previous studies have reported that people's involvement in some physical activity may reduce their anxiety levels indicating that those with a sedentary lifestyle had higher levels of anxiety compared to people who were involved in sport or participated in some type of activity (Johnston et al., 2020; Tyson, Wilson, Crone, Brailsford, Laws, 2010). Participation in sport not only reduces the state of anxiety but also reduces anxiety associated with daily life (Bäckmand et al., 2001), i.e., people engaged in sports have lower levels of anxiety than those who have never played

a sport before (Bäckmand et al., 2001; 2009; Cevada et al., 2012). Cevada et al. (2012) found that former gymnasts had lower level of anxiety compared to non-athletes and they showed no significant differences from former athletes of other sports.

Depression is a condition that negatively affects the way we feel, creates feelings of sadness, melancholy and frustration, and as a result affects the way we think and act. Lauber, Falcato, Nordt, Rössler (2003) argued that the most common causes that lead a person to this condition are difficulties within the family, stress from work, and generally unspecified stress, as well as traumatic experiences or illness. A large number of studies suggest exercise as an aid to reduce depressive symptoms in the population, even in patients with severe depression (Deslandes et al., 2009; Dimeo, Bauer, Varahram, Proest, Halter, 2001; Nabkasorn et al., 2005; Ströhle, 2008). When people participate in some physical activity, their body image and their physical condition improve, their self-esteem and their relations with the social environment are strengthened, and as a result the level of depression is reduced (Babiss, & Gangwisch, 2009). Former athletes who have withdrawn from sport for a long period have greater life satisfaction and fewer depressive symptoms than people who have never been involved in any sport (Bäckmand et al., 2001).

Throughout their careers, AGs have higher levels of psychological anxiety compared to non-athletes (Georgopoulos et al., 2011). But during the transition period when athletes withdraw from sport, they experience a stress-free release with positive dimensions as they can find a new role in life and become more socially active (Clowes, Lindsay, Fawcett, and Knowles, 2015). However, Wylleman, Alfermann and Lavallee (2004) report that withdrawal from AG can cause various psychological and emotional adjustment difficulties, such as depression, eating disorders, low self-esteem, etc. There are generally not enough studies that look at the QoL and level of anxiety and depression in former gymnasts after years of retirement. Thus, the purpose of this study was to assess the quality of life (QoL), the level of anxiety (STAI) and the level of depression (BDI) in former artistic gymnasts (FAG), former gymnasts from other sports (GOS), and non-athletes (CG). It also examines if there is a gender effect on these parameters. It was hypothesized that there was no statistically significant difference between the three groups on the aforementioned parameters and that there were no differences in relation to gender.

METHOD

The present study involved 114 healthy participants (75 women and 39 men) with a mean age 27.11 ± 9.92 years, ranging from 20 to 59 years. The sample was divided into 3 different groups. 39 former artistic gymnasts (FAG) (mean age 30.03 ± 9.85 years) participated in the first group, and there were 53 former gymnasts from other sports (rhythmic gymnastics, acrobatic, gymnastics for all) (mean age 27.28 ± 11.07 years) (GOS) in second group. The main criterion for participation was: (i) to have at least 7 years of competitive experience so that they reached a high level in their sport; and (ii) to be out of sports for at least 2 years so that there is a sufficient withdrawal period. The third group was the control group (CG) consisting of 22 people who had never been involved in sports before (non-athletes) (mean age of 21.55 ± 1.50 years).

The present study is an experimental process, where participants were asked to complete 3 different questionnaires so that it was possible to assess their QoL, level of anxiety (STAI) and level of depression (BDI), respectively. To complete the questionnaires and collect the data, a discussion with each participant preceded, to assess whether they met all the criteria required for the survey. All questionnaires

were sent electronically; participants were given precise instructions on how to complete them. The questionnaires were completed anonymously to ensure that they elicited as honest answers as possible.

Quality of Life Questionnaire SF-36.
This questionnaire is used to measure and assess the health status of the population. It is a reliable measuring tool that addresses the basic dimensions of quality of life (QoL) (Yfantopoulos, Sarris 2015). The questionnaire consists of 36 closed-ended questions which are summarized in 8 scales. The scales are: (i) General Health; (ii) Mental Health; (iii) Physical Functionality; (iv) Social Functionality; (v) Physical Role; (vi) Emotional Role; (vii) Physical Pain, and (viii) Vitality (energy and fatigue) (Ware & Sherbourne, 1992; Yfantopoulos & Sarris 2015). These eight scales form two general scales, concerning physical and mental health. The scoring ranges from 0-100. The higher the score, the better the QoL.

State- Trait Anxiety Inventory (STAI).
The STAI is a self-reporting questionnaire for measuring anxiety and consists of 40 phrases that people often use to describe themselves. This questionnaire was created by Spielberger et al. (1970). It is divided into two subscales: "State Anxiety", and "Trait Anxiety", and examines the status of anxiety and anxiety as a personality trait respectively (Marteau, & Bekker, 1992). The first subscale consists of 20 questions about how the participant feels the moment he / she answers the "State Anxiety" questionnaire. Participants indicate the degree to which each question characterizes them, based on a four-point scale (1. Not at all, 2. Somewhat, 3. Moderate, 4. Too much). The second sub-scale consists of 20 further questions related to anxiety as a personality trait. It reflects the most general condition of the person and assesses the level of anxiety as a personal trait. Participants in this sub-scale also state the degree to which each question characterizes them, based on a four-point scale (1. Almost Never, 2. Occasionally, 3. Often, 4. Always). Each question is scored from 1 to 4. Initially, the sums of the first sub-scale "State" and the second sub-scale "Trait" are calculated. Then we add up the sum of the 2 questionnaires and if the total score is in the range between 20 and 37, it shows low anxiety; between 38 and 44 moderate anxiety, and between 45 and 80 high anxiety.

Beck Depression Inventory (BDI)
The BDI was first introduced in 1961, and it has been devised by Beck, Steer, and Carbin. (1988). It is a self-reporting questionnaire consisting of 21 questions that refer to a person's behavioral characteristics and depressive symptoms. Each question has 4 possible answers (0-3) and participants are asked to evaluate how much each applies to them. The questions relate to: (i) mood, (ii) pessimism, (iii) feeling of failure, (iv) feeling of satisfaction, (v) feeling of guilt, (vi) feeling of punishment, (vii) self-loathing, (viii) automorphic, (ix) the idea of suicide, (x) crying, (xi) irritability, (xii) social withdrawal, (xiii) indecision, (xiv) body image, (xv) decreased productivity, (xvi) sleep disturbance, (xvii) easy fatigue, (xviii) loss of appetite, (xix) weight loss, (xx) physical discomfort, (xxi) and loss of libido (Beck et al., 1988). Each answer is scored from 0-3. To determine the level of depression, the individual's answers are added up. If the sum is in the range between 0 and 9, it shows minimal depression; between 10 and18 mild depression; between 19 and 29 moderate depression, and between 30 and 63, it indicates severe depression.

The statistical analysis was performed with the analysis of variance in order to examine the differences in the dependent variables (QoL, STAI, BDI) in FAG, GOS, and CG. Correlation analysis was also used to determine the relationship between the

three variables examined. The statistical analysis was performed with the statistical package SPSS v. 22 (SPCC Inc., Chicago, IL) and data are presented with averages and standard deviations. All statistical significances were tested at a = 0.05.

RESULTS

The mean and standard deviation of the examined variables in the whole sample were 7.56 ± 5.90, 40.31 ± 10.20, and 74.66 ± 15.44 for BDI, STAI and QoL, respectively. The statistical analysis showed a significant difference between the groups in terms of BDI ($F_{(2)} = 3.637$, $p = .030$). This is determined by the difference between the FAG and CG ($p < .05$). In contrast, there was no difference between the FAG and GOS. Regarding the STAI, no statistical differences were found between the groups ($F_{(2)} = 0.908$, $p = .406$), and there was no statistically significant difference in QoL ($F_{(2)} = 1.637$, $p = .198$). The means and standard deviations of the examined variables per group are presented in Table 1.

Table 1
Means and standard deviation of the examined variables.

	FAG (n = 39)	GOS (n = 53)	CG (n = 22)
QoL	75.08 ± 14.42 ¥	76.49 ± 15.08 ¥	69.49 ± 17.54
STAI	40.75 ± 8.91 ¥	39.09 ± 11.50 ¥	42.47 ± 8.93
BDI	6.54 ± 4.20 ¥	7.09 ± 5.67 ¥	10.50 ± 8.02

Note: ¥ significant difference compared to CG; FAG: Former Artistic Gymnasts; GOS: Former gymnasts from other sports; CG: Non-athletes; QoL: Quality of Life; BDI: STAI: State- Trait Anxiety Inventory; BDI: Beck Depression Inventory

In addition, the gender factor (FAG in relation to GOS) does not differ in any of the examined variables, which means that there are no differences in the examined variables; (i) QoL: ($F_{(2)} = 2.123$, $p = .148$, STAI: ($F_{(2)} = 3.039$, $p = .084$, BDI: ($F_{(2)} = .496$, $p = .483$). Correlation analysis showed a negative relationship between BDI and SF36 ($r = -.634$, $p = .01$), as well as between STAI and SF36 ($r = -.650$, $p = .01$). In contrast, a positive correlation was observed between BDI and STAI ($r = .597$, $p = .01$)

DISCUSSION

The purpose of the study was to assess the QoL, STAI, and BDI among former artistic gymnasts (FAG), former gymnasts from other branches (GOS), and non-athletes (CG). The results of our study verify our initial hypothesis regarding the QoL. Although there was no statistically significant difference between the 3 groups, the FAG and GOS had higher values, indicating that, in general, former gymnasts have a better QoL than non-athletes. Our results partially agree with the findings of Filbay et al. (2019) who found a better QoF in former athletes, especially on mental function. According to these authors, there is a possibility that sport has a positive or even negative effect on the QoL of former athletes during their later life. In addition, our results are in line with the findings by Bäckmand et al. (2001) which show that former athletes have a better functional capacity and better QoL than non-athletes; and also those of Cevada et al. (2012) who found that former athletes had better results on emotional aspects and their general health compared

to non-athletes. Furthermore, our results support previous data of Snyder et al. (2010) who found that athletes had better QoL than non-athletes, both in mental health and in physical and social aspects. It seems that participation in sports has positive psychological effects that remain beyond athletes' engagement in sport and enhance their QoF (Filbay et al., 2019). Regarding the level of QoL among former athletes, our findings support data by Bullock, Collins, Peirce, Arden and Filbay (2020) who found that former cricketers reported similar physical components of health-related QoL.

Concerning STAI, our results showed that there was a tendency in FAG and GOS to have less anxiety than CG. This finding is in agreement with previous data of Bäckmand et al. (2001) who examined the personality and mood of former athletes at an older age and found that there were no statistically significant differences between former athletes and CG in terms of their level of anxiety. However, the same authors in a subsequent study (Bäckmand et al., 2009) found that former athletes had lower levels of anxiety than people who have not been involved in a sport before. Therefore, it seems that even in this variable former athletes posted better results than non-athletes. In addition, as Morgan stated, participation in sport reduces anxiety; the most significant benefit gained from exercise is a reduction in anxiety in relation to everyday life, and a tendency to prevent anxiety from becoming chronic (Morgan, 1979). This finding is verified by Tyson et al. (2010) who evaluated the effect of physical activity on anxiety levels and found that those who engage in a sport or in some type of physical activity have much less anxiety than those who lead a sedentary lifestyle. These data support Morgan's findings who concluded that exercise can not only reduce anxiety and personality anxiety, but can prevent this anxiety from becoming chronic (Morgan, 1979). The fact that we didn't find statistically significant differences between former athletes and non-athletes may be due to the fact that during their careers, as reported by Georgopoulos et al. (2011), AGs have higher levels of psychological stress compared to non-athletes. In addition, our results could be supported by data of Wylleman et al. (2004) who report that during the transition period, when AGs retire from their sport, they may experience various psychological and emotional adjustment difficulties. The fact that our sample included high level athletes justifies the absence of significant differences between former gymnasts, confirming findings by Masten that support the claim that athletes competing at the highest competition level exhibit higher levels of STAI compared to those at lower levels (Masten, 2016). Furthermore, the absence of gender effect on anxiety agrees with Sari's findings which revealed that male and female badminton athletes did not differ in this variable (Sari, 2015). Based on the literature, it seems that anxiety is less understandable, since both views are supported - more anxiety in athletes' transitional life, or less anxiety and a sense of liberation. This is probably related to the way each practitioner deals with this sudden loss of something they did for most of their life.

Concerning BDI, our results verify our initial hypothesis that FAG will have less depression than CG and that FAG will not differ significantly from GOS. The statistically significant difference between FAG and CG verifies previous data of Cevada et al. (2012) who found that former AGs who retired from their sport a long time ago reported lower rates of BDI compared to people who never participated in sports. Also, the results of the present study are in line with the results of Bäckmand et al. (2001) who found that former athletes had more life satisfaction and showed fewer depressive symptoms than people who never engaged in sports. The fact that there was no gender effect on BDI is a finding that contradicts previous

data that showed that female college athletes had higher levels of depression than male college athletes (Armstrong & Oomen-Earl, 2009). Our research also supports the results of a previous study (Dimeo et al., 2001) which examined participants with mild to moderate depression who participated in a training program and reported that exercise could reduce the level of depression. This is confirmed by a large number of studies proposing exercise as a means of helping to reduce depression (Deslandes et al., 2009; Dimeo et al., 2001; Nabkasorn et al., 2005; Ströhle, 2008). Generally, exercise has long-term benefits not only at the physical but also on the mental and emotional level (Bäckmand et al., 2001).

, AGs must undergo countless hours of training from an early age in order to excel in their sport. According to previous findings (Krane, Greenleaf, & Snow, 1997; Lavallee & Robinson, 2007), one of the consequences is that when athletes stop their training and competitive duties some find their withdrawal overwhelming and therefore experience a crisis, while others experience a positive transition with very few problems (Baillie, 1993). In general, although there are many differences between the four types of sports (AG, RG, acrobatics, gymnastics for all), it seems that when we refer to a high level of athletes, the requirements of these sports have the same effect on the examined parameters. Consequently competitive gymnastics requires athletes to perform under time constrains and meet accuracy requirements, all of which increase the state of anxiety in athletes. As a result, some former gymnasts feel they meet their daily obligations more easily once they end their sporting career, and for this reason they present lower levels of anxiety and depression.

CONCLUSIONS

Former gymnasts have less depression, better quality of life and less anxiety compared to people who have not been involved in a sport before. In conclusion, former gymnasts, even after years of absence from the sport, are in possession of greater life satisfaction, better functional capacity, fewer symptoms of depression and a better quality of life than non-athletes.

RESEARCH BOUNDARIES AND LIMITATIONS

The results of the present study, however, cannot be generalized. The results should be taken with some specific limitations, mainly in terms of the sample that participated in the research. Research only refers to former gymnasts who had at least 7 years of competitive experience and were inactive from their sport for at least 2 years. Further, it is worth noting that this research was conducted during the coronavirus period and, specifically, during the lock-down period which certainly affected the mental state of our participants and consequently our results.

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GENDER DIFFERENCES IN UNIVERSITY STUDENTS' GYMNASTICS SPECIFIC SELF-EFFICACY AND PERFORMANCE

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Abstract

The aim of the study was to examine differences between male and female university students and their gymnastics specific self-efficacy and performance in gymnastics. In the study, 201 male and 160 female students and their 7 teachers participated voluntarily. The students attended the second year in the School of Physical Education and Sport Science (SPESS) and were obliged to take the course "Teaching of Gymnastics" for two semesters. Students' self-efficacy was evaluated by suitable questionnaires at the beginning of the academic year, at the end of the first semester, and at the end of the academic year. Gymnastics skills' difficulty was evaluated by teachers, and students' performance was graded by their teachers at the end of the first semester, and at the end of the academic year. The main findings were: (a) both genders increased their self-efficacy during the academic year, while females had higher overall self-efficacy towards all gymnastics apparatus than males' in the three measurements; (b) there were no gender differences in the average of the three measurements of self-efficacy toward common gymnastics skills; (c) there were no differences in gymnastics skills' difficulty performed by males and females, and (d) females received higher grades than males. Considering the limitations of the study, the findings can be very useful for more effective organization and teaching of university gymnastics courses.

Keywords: *Self-efficacy, Artistic gymnastics, Males, Females, Performance.*

INTRODUCTION

Gymnastics is considered a very important sport for the motor development of children (Nilges, 1997) and for this reason it is included in the curricula of physical education at every level of education. Gymnastics is taught as a core compulsory applied course for two semesters in the second year to students in the School of Physical Education and Sport Science (SPESS). The syllabus of the course focuses on the development of the dominant movement patterns: locomotion, statics/balance, spring, landing, rotation/rolling, flight, and swing. The practical content of the course includes gymnastics skills at a basic level for each of the 4 apparatus for female and the 6 apparatus for male students respectively (MAG; WAG, Code of points, Fédération Internationale de Gymnastique, 2020a,b). Students must attend at least 70% of the three-hour weekly classes (two practical and one theoretical) to meet the requirements of the course in each semester. To successfully pass the exams, students must be graded with an average of at least 5 (out of 10) in practical (60%) and

theoretical (40%) examination of the course.

In the context of improving the quality of the course, some of the issues that concern teachers who teach gymnastics at the SPESS are poor performance of some students; non-participation in the practical part of the course for various reasons; failure to attend at least 70% of the three-hour weekly classes needed to fulfill the requirements to pass the course; dropout and abstention from the course exams at the end of semester. Specifically, our analysis of the data from the previous academic year included the present investigation showed that about 24% of students, did not attend at all in the fall semester, or did not engage in the practical course of gymnastics for a variety of reasons (unknown). About 14% did not participate at all in the exam, and 12% got below the baseline. In the spring semester, the situation was even worse: 29% did not attend, 23% did not participate in the exam, and 8% got below baseline (total percentage greater than 50%).

Self-efficacy is the self-evaluation of one's competence to successfully perform a specific task or to obtain specific performance outcomes in a particular situation (Bandura, 1997; Pajares, 1996). Self-efficacy expectations influence the task selection; expenditure of effort; persistence in the face of barriers; resilience, and ultimately behavior (Bandura, 1997; Bandura, & Schunk, 1981); personal goals and performance (Locke. & Latham, 1990), and goal setting and commitment; cognitive actions, and affective processes (Maddux, 1995). Self-efficacy has been well-researched as one of the most influential psychological concepts affecting motivation to engage to achieve results in sport performance (Moritz, Feltz, Fahrbach, & Mack, 2000; Vealey, Hayashi, Garner-Holman, & Giacobbi, 1998). Considering that the development of specific skills and performance in gymnastics requires strong motivation, courage, determination, personal goals and commitment, it can be assumed that the importance of perceived self-efficacy is crucial (Ede, Hwang, & Feltz, 2011). Furthermore, research results have demonstrated that students' skill-specific self-efficacy in gymnastics significantly predicted their performance at the end of the two semester course (Milosis et al., 2018).

Self-efficacy is a multidimensional construct (Zimmerman, 2000), directly related to a specific activity domain (Bandura, 1997; Maddux, 1995), and can be specific to a task at a particular level of performance (Yeo, & Neal, 2006). Considering the situational specific nature of self-efficacy, researchers typically develop self-efficacy scales specific to the research environment in which they are to be applied (Bandura, 1997; Lane, Devonport, Milton, & Williams, 2003). Such measurements evaluate students' judgments about their capabilities to have a clear activity or task in mind, and allow researchers to relate self-efficacy to achievement and to predict performance (Bandura, 1986; Pajares, 1996). Correspondingly, in sport and physical activity settings, it has been found that task-specific scales predict better specific tasks (McAuley, & Gill, 1983). Significant positive correlations between self-efficacy and subsequent performance measurements have been reported for gymnastics among other sports (Ede, Hwang, & Feltz, 2011). For example, Weiss, Wiese, and Klint (1989) have concluded that artistic gymnasts with higher expectations of final achievement before a competition tended to be more successful than gymnasts with low expectations of success.

However, the nature of the activity and the situation under consideration are determining factors for the level of specificity where self-efficacy is measured (Bandura, 1992). For example, a high-level basketball player may have higher perceptions of self-efficacy on the basketball court, but might lack self-

confidence if required to perform a routine on the trampoline (McAuley, & Gill, 1983). However, it is possible that even within a domain of action one may have high self-efficacy for one parameter of performance but not another. For example, it is doubtful whether the performance of the forward roll could predict the performance on the cartwheel due to the different degree of difficulty of the skills (LaForge-MacKenie, & Sullivan, 2014). Thus, it is possible that a female student is highly efficacious for a turn or a jump performed on the floor apparatus, but inefficacious for the same skill executed on the balance beam. Correspondingly, a male student is likely to have a high level of self-efficacy to perform a handstand on the floor, but a lower level to execute the handstand on the parallel bars. Also, a male student may have higher self-efficacy to perform a forward tucked salto on the floor compared to a female student, but lower self-efficacy to perform a handspring on the floor compared to the same female student.

Many attempts have been made to investigate the factors that may affect different performance and achievement of the two genders' defining perceptions about the self as a key parameter (e.g., Eisenberg, Martin, & Fabes, 1996). Gender differences in psychological parameters have been reported by many researchers and perhaps the most researched topic in sport psychology has been in the area of self-efficacy/self-confidence (Lirgg, George, Chase, & Ferguson, 1996).

In general, most self-efficacy research has concluded that male athletes consistently evaluate higher their overall physical competence and are more positive than female athletes about their ability and their performance expectations in most traditional sport activities (Moritz et al., 2000; Rattanakoses et al., 2009; Woodman, & Hardy's, 2003). Conversely, it was hypothesized that females would give lower performance estimates, perform more poorly, report a lower ability level, and attribute success or failure to external causes when compared to males in a competitive task (Corbin, & Nix, 1979; Woodman, & Hardy, 2003).

However, it has been suggested that gender identity and gender stereotypes may affect sports competence and self-efficacy. Gender identity is a complex, multidimensional construct which evaluates one's self-appraisal of being male or female (Egan, & Perry, 2001). Gender stereotypes relate to children's beliefs about behavioral differences between the genders (and the desirability of such differences), specifying that certain behaviors are more important for, or more common to, one gender than the other. According to Choi (2004), self-efficacy is related to gender-role orientation, masculinity or femininity. Masculinity operationalizes self-efficacy through competitiveness, independence, aggressiveness, and assertiveness. Self-efficacy is related to femininity when it is in the domain of submissiveness, dependence, and interpersonal relationships. Earlier studies provided support for this theory. For example, findings supported that if an activity is considered more masculine, females will have less self-efficacy in the task (Corbin, & Nix, 1979; Lirgg et al., 1996; Sanguinetti, Lee, & Nelson, 1985). On the other hand, females had higher self-perceptions of ability and expectancies for success than males on activities considered more feminine, for example dance, gymnastics, figure skating, cheerleading, etc. (Lirgg et al, 1996; Clifton, & Gill, 1994). In general, females were less confident than males on a perceived masculine task, and males were less confident than females on a perceived feminine task (Lirgg, 1996).

Gymnastics has been described as a sport that includes different combinations of aesthetic and acrobatic dimensions (Goirand, 1996). According to the literature, those dimensions are marked by gendered stereotypes, defining the

aesthetics of a movement as feminine and the acrobatic dimension as masculine (Kirk, 2010). It has still been argued that the more decisive the force for the execution of a skill is, the more masculine it can be considered (Whitson, 1994). In gymnastics, males perform skills and exercises in 6 "men's" apparatus, and females in 4 "women's" apparatus. There are skills performed by both genders (e.g., cartwheel, forward or backward handspring or salto), skills performed only by males (e.g., cross support on still rings) or only by females (e.g., jumps, leaps, turns on balance beam).

Following the guidance obtained from the prior literature review, the aim of the study was to verify whether there were substantial differences between male and female students' gymnastics specific self-efficacy and performance in gymnastics skills in a sample of university students. As gender differences existed in most sports self-efficacy in general, it was hypothesized that gender differences exist in gymnastics self-efficacy as well. Exploring students' gymnastics-specific self-efficacy is important for a better understanding of how to better organize and teach a gymnastics course to increase male and female students' self-efficacy beliefs and eventually their performance in gymnastics skills and exercises.

METHODS

In the study, 361 students (201 males; M = 20.16 years old, SD = 2.44, and 160 females; M = 19.95 years old, SD = 2.30) who attended the second year in the School of Physical Education and Sport Science (SPESS) and their 7 teachers (over 20 years of experience) participated voluntarily. Data collected from five students (2 males and 3 females) who were competitive gymnastics athletes in the past were excluded from the statistical analyses. According to the curriculum of the SPESS, all students were obliged to attend the course "Teaching of Gymnastics" for two semesters. The teaching of fundamental gymnastics skills for male and female students (e.g., forward, and backward roll, cartwheel, headstand, handstand) is included in the Greek physical education curriculum for primary and secondary education. However, due to a lack of gymnastics facilities and suitable equipment in Greek schools, most Greek students have been taught gymnastics at a very low level or not at all. Consequently, the participants that were involved in the present study had very little or no experience and were considered as novices in gymnastics. Participants were informed that the purpose of the research was to improve the course "Didactics of Gymnastics", that their answers in the questionnaire were confidential and would not be disclosed to third parties, and that they would not affect their grades in the two semesters. All participants were fully informed about the purpose of the study and the implementation of the protocols, according to the Ethical Committee of the University guidelines. Written informed consent was obtained from all participants.

For the evaluation of students' self-efficacy, two reliable and valid skill-specific self-efficacy questionnaires individualized for male and female students were used. Particularly, males' questionnaire consisted of 33 skills-specific items divided into 6 subscales, one for each apparatus (11 items for MFX, 3 for PH, 3 for SR, 3 for MV, 7 for PB, and 6 for HB). Accordingly, females' questionnaire consisted of 41 skills-specific items divided into 4 subscales, one for each apparatus (3 items for FV, 9 for UB, 14 for BB, and 15 for FFX). The level of difficulty of the skills presented to the students was evaluated by 7 teachers (with over 20 years of experience each) who taught in the SPESS gymnastics courses and who had themselves responded to a properly designed questionnaire. To investigate gender differences in self-efficacy, only the items for the skills that were common to male and female students

were used [9 skills on the FX, 3 on the V, and 4 on the HB and UB (HBUB) (Table 1)]. The vault skills were presented (and performed) on the "vaulting horse" (pommel horse, but without the handles placed sideways) for females, and on the "vaulting table" for male students respectively. The squat through and the straggle over vault skills were performed using springboard and the handspring using mini trampoline for both genders. Furthermore, video elicitation based on criteria for the optimal performance was used as a tool to provide students an accurate movement of execution of each gymnastic skill that was to perform. The instruments used in the present study were developed for the evaluation of second year students' gymnastics self-efficacy, based on the curriculum of the compulsory course "Teaching of Gymnastics" of SPESS (Milosis et al., 2018).

Table 1
Common gymnastics skills for male and female students.

Floor exercise	
Forward handspring	Backward roll to handstand
Back standing scale	Forward roll tucked
Salto forward tucked	Backward roll tucked
Handstand forward roll	Round off
Cartwheel	
Vault	**Horizontal bar/Uneven bars**
Squat through	Glide kip
Straddle over	From hang pull over to support
Forward handspring	Back hip circle
	Underswing dismount

The questionnaire evaluating the level of difficulty of the gymnastics skills was completed by the teachers before the beginning of the first semester. The self-efficacy questionnaire was completed by the students three times during the academic year: (a) in the first gymnastics lesson at the beginning of the first semester; (b) in the last lesson of the first semester before the examinations, and (c) in the last lesson of the second semester before the final examinations for the academic year. Before the process began, it was highlighted to the students that the skills would be presented in random order regardless of their difficulty. In addition, students were asked not to comment on the difficulty of the skills so that they would not affect their co-examined peers either positively or negatively. Then, corresponding video clips related to the technical execution of each skill were projected.

Each video clip was screened twice so that the students could get the best picture of the performance required based on the criteria that were set in the design of the study. Immediately afterwards, students were asked to answer one self-efficacy question regarding the presented gymnastics skill. For example, for the skill "squat through" on the "vaulting horse" for female students, the corresponding video clip related to the technical execution was projected and the following question was posed to female students: "How confident are you that after your participation in the gymnastics courses you will be able to perform the 'squat through' on the 'vaulting horse' at the end of the academic year in the way shown in the video?" Afterwards, students rated their confidence on a 10-point scale (1 = not at all confident, 10 = extremely confident). The above procedure was followed throughout the questionnaire for both male and female

students and lasted 30-40 minutes for each measurement.

Students' grades from their teachers (n = 7) for the first and the second semester based on their performance in the practical examination were collected. Specifically, the students performed all the skills on the six apparatus for males and four apparatus for females and were evaluated by their teachers and graded from 1 to 10 for each skill according to the quality of execution. Each skill was evaluated and assessed in 2-7 predefined criteria for quality execution depending on the magnitude of the deviation from perfect execution. The content validity of the criteria used were tested in a previews study (Milosis et al., 2018). The average score of all apparatus (ALL) for males and females was calculated and was used in statistical analyses (Table 4).

The normality of the data was examined using Kolmogorov-Smirnov Test. A p value less than 0.05 was considered significant. The data were analysed using the SPSS software (SPSS v. 23, SPSS Statistics, IBM Corp., NY USA). The internal consistency of students' self-efficacy towards each gymnastics apparatus was assessed using the Cronbach's alpha coefficient. The differences between the evaluation of male and female skills' difficulty by their teachers were examined using multivariate analysis of variance (MANOVA). To examine gender effects on students' self-efficacy and grades, repeated-measures ANOVAs were used.

RESULTS

Reliability, repeatability, content, concurrent, and predictive validity of the instruments used were supported by the results of a previous study (Milosis et al., 2018). The frequency distributions of self-efficacy sum scores come close to a normal distribution. For both males and females, skewness and kurtosis had values between –1.0 and +1.0. Kolmogorov-Smirnov test of normality was not significant $p > .05$. The alpha reliability coefficient was satisfactory for all variables (Tables 1, 2).

Differences in students' self-efficacy during the academic year

Repeated-measures analyses of variance were conducted in order to examine changes in students' self-efficacy during the academic year. More specifically, they tested within-subjects effects between the three measurements of male and female students' self-efficacy towards each gymnastics apparatus as illustrated in the following. Males' apparatus MFX, PH, SR, MV, PB, HB, and the mean score of all apparatus (MALL); Females' apparatus FV, UB, BB, FFX, and the mean score of all apparatus (FALL).

Differences in males' self-efficacy during the academic year

Separate repeated-measures ANOVAs were conducted with students' self-efficacy towards each gymnastics apparatus as dependent variable and time of measurement as the within-subjects factor. Results revealed that there was a significant within-subjects effect for students' self-efficacy towards each gymnastics apparatus (see Table 2): (a) MFX, $F(2,400) = 30.25$, $p < .001$, $\eta^2 = .13$, (b) PH, $F(2,400) = 44.07$, $p < .001$, $\eta^2 = .18$, (c) SR, $F(2,400) = 95.74$, $p < .001$, $\eta^2 = .32$, (d) MV, $F(2,400) = 46.18$, $p < .001$, $\eta^2 = .19$, (e) PB, $F(2,400) = 28.87$, $p < .001$, $\eta^2 = .13$, (f) HB, $F(2,400) = 26.20$, $p < .001$, $\eta^2 = .12$, and (g) MALL, $F(2,400) = 92.32$, $p < .001$, $\eta^2 = .32$. Pairwise comparisons revealed that except for the measurements of the initial and the first semester for the PB, males' self-efficacy increased significantly ($p < .005$) measurement by measurement (Table 1, Figure 1).

Table 1
Means (M), standard deviations (SD), alpha reliabilities, significant differences (F), and effect size (η²) of males (n = 201) self-efficacy, for the three measurements.

	Initial Measure			End of First Semester			End of Second Semester				
	M	*SD*	α	*M*	*SD*	α	*M*	*SD*	α	*F*	η²
MFX	6.21	1.50	.89	6.46	1.68	.92	6.92	1.67	.91	30.25	.13
PH	5.22	1.64	.86	6.11	1.81	.82	6.43	1.62	.61	44.07	.18
SR	4.60	2.07	.89	5.83	2.18	.89	6.78	2.01	.89	95.74	.32
MV	5.23	1.98	.90	6.00	2.01	.87	6.60	1.94	.84	46.18	.19
PB	**5.78**	1.63	.90	**5.83**	1.79	.92	6.57	1.80	.91	28.87	.13
HB	5.20	1.75	.89	5.81	1.84	.91	6.02	1.90	.89	26.20	.12
MALL	5.39	1.47	.96	6.03	1.70	.97	6.60	1.62	.97	92.32	.32

Abbreviations: MFX, males' floor exercise; PH, pommel horse; SR, still rings; MV, males' vault; P, parallel bars; HB, horizontal bar; MALL, the mean score on all males' apparatus. Excluding the means of the initial and first semester for the males' PB (means in boldface), all means differed significantly between the three measurements (p < .05). All F statistics were statistically significant (p < .001).

Table 2
Means (M), standard deviations (SD), alpha reliabilities, significant differences (F), and effect size (η²) of females (n = 160) self-efficacy, for the three measurements.

	Initial Measure			End of First Semester			End of Second Semester				
	M	*SD*	α	*M*	*SD*	α	*M*	*SD*	α	*F*	η²
FV	4.78	1.86	.85	5.95	1.93	.87	6.75	1.72	.73	96.30	.38
UB	5.97	1.48	.91	6.68	1.58	.91	7.22	1.68	.89	51.26	.24
BB	6.44	1.84	.95	7.38	1.47	.94	7.78	1.41	.93	82.58	.34
FFX	6.68	1.78	.94	**7.26**	1.48	.93	**7.23**	1.63	.93	18.56	.11
FALL	5.98	1.48	.97	6.84	1.39	.96	7.28	1.47	.97	144.13	.48

Abbreviations: FV, females' vault; UB, uneven bar; BB, balance beam, FFX, females' floor exercise, FALL, the mean score on all females' apparatus.
Excluding the means of the first and second semester for the females' FFX (means in boldface), all means differed significantly between the three measurements (p < .05). All F statistics were statistically significant (p < .001).

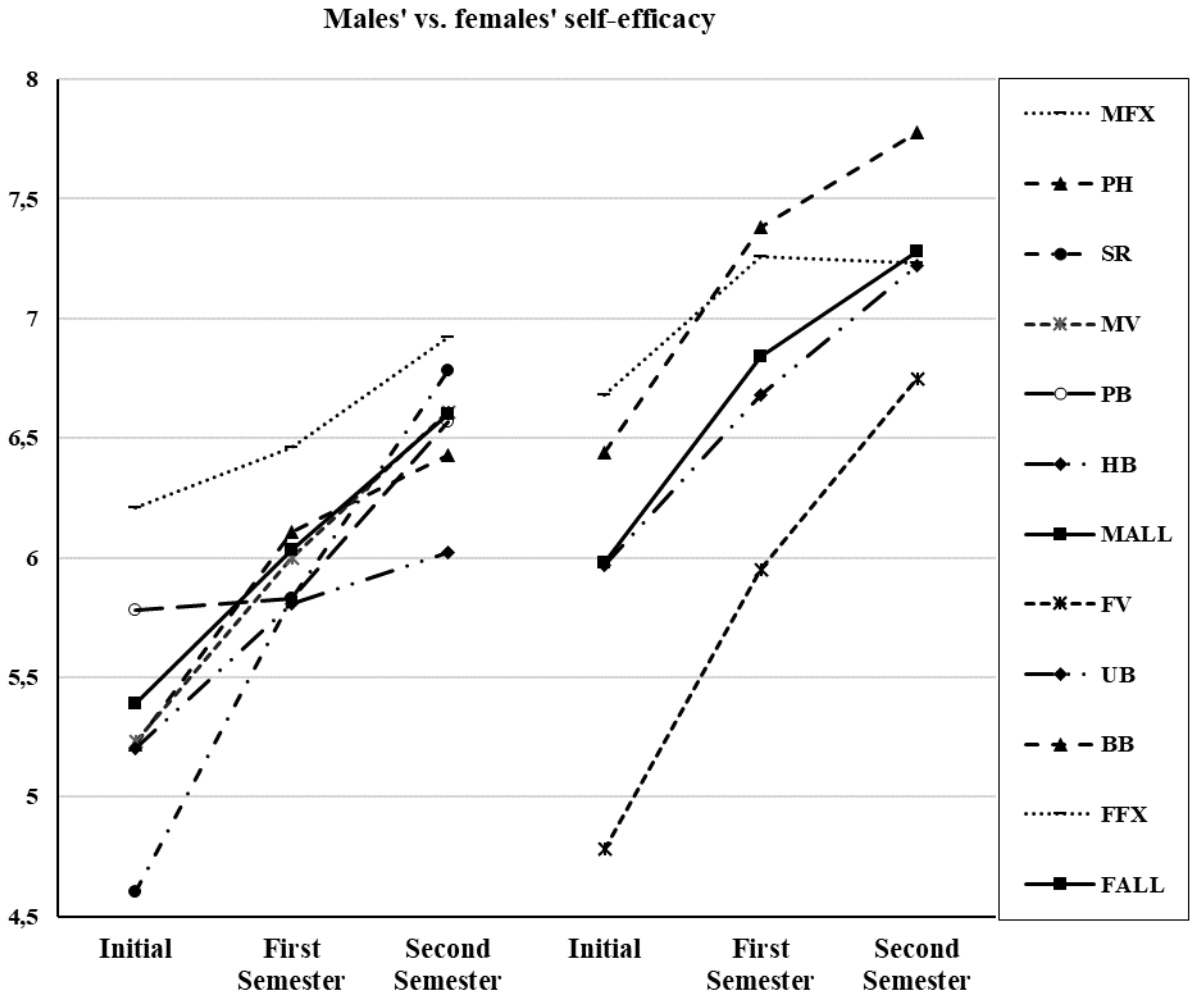

Figure 1. Males' vs. females' self-efficacy towards each gymnastics apparatus and the mean score of all apparatus for the three measurements. Excluding the measurements for the initial and first semester for the PB (male) and for the first and the second semester for the FFX (female) self-efficacy increased significantly ($p < .05$) measurement by measurement.
Abbreviations: MFX, males' floor exercise; PH, pommel horse; SR, still rings; MV, males' vault; PB, parallel bars; HB, horizontal bar; MALL, the mean score of all males' apparatus; TMALL, teachers' evaluation of difficulty for of all males' apparatus; FV, females' vault; UB, uneven bar; BB, balance beam, FFX, females' floor exercise, FALL, the mean score of all females' apparatus; TFALL, teachers' evaluation of difficulty for of all females' apparatus.

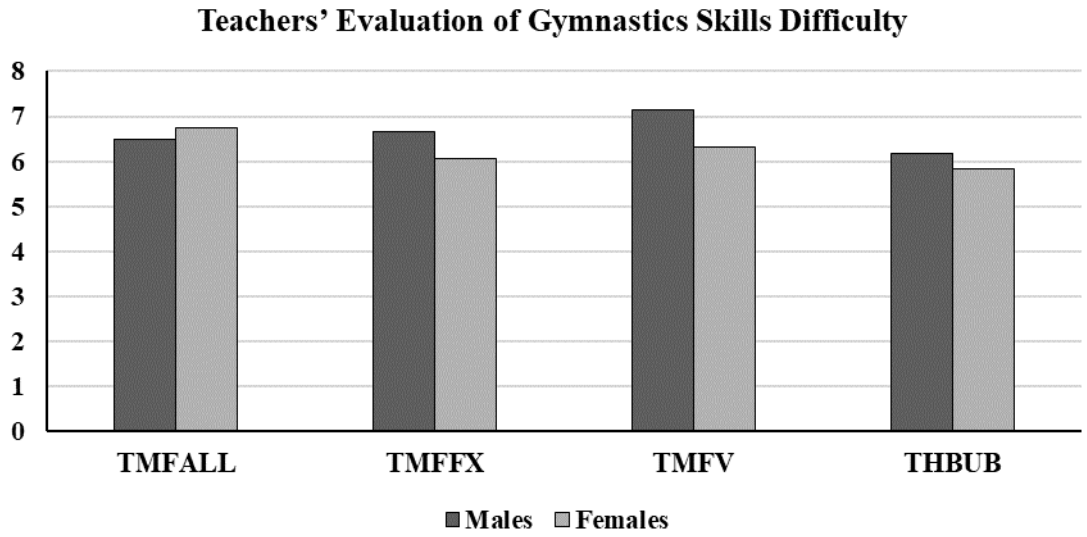

Figure 2. Teachers' evaluation of gymnastics skills difficulty.
Abbreviations: TMFALL, teacher evaluation for the total number of gymnastics skills on the six males' and four females' apparatus; TMFFX, teacher evaluation for the nine common gymnastics skills for males and females on the floor exercise; TMFV, teacher evaluation for the three common gymnastics skills on the vault; THBUB, teacher evaluation for the four common gymnastics skills on the horizontal bar and the uneven bars. Higher scores represent lower difficulty.

Table 3
Descriptive statistics for contrast effects followed the within subjects interaction between group and time.

	Initial measure				End of first semester				End of second semester					
	Males		Females		Males		Females		Males		Females			
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*F*	η^2
ALL	5.39	1.47	5.98	1.48	6.03	1.70	**6.84**	1.39	6.60	1.62	7.28	1.47	4.37*	.01
FX	6.09	1.37	5.95	1.76	6.42	1.44	**6.56**	1.50	6.63	1.49	6.63	1.49	6.41**	.02
V	5.32	1.87	4.80	1.86	5.97	1.87	5.78	1.82	6.47	1.85	**6.70**	1.54	6.48**	.02
HBUB	4.59	1.79	5.19	1.89	**5.49**	1.89	5.64	1.81	5.75	1.68	5.98	1.88	7.61**	.02
Grades					6.58	1.80	**7.41**	1.68	6.18	1.08	**7.03**	1.86	11.74***	.05

Abbreviations: M, Means; SD, Standard deviations; F, Significant differences; η^2, Effect size; ALL, the total number of gymnastics skills on the six males' and four females' apparatus; F, nine common gymnastics skills for males and females on the floor exercise; V, the three common gymnastics skills on the vault; HBUB, four common gymnastics skills on the HB and UB.
Means in boldface were increased more compared to the corresponding mean of the opposite gender relatively with the means of the prior measurement.
**p < .05, **p < .01, ***p < .001*

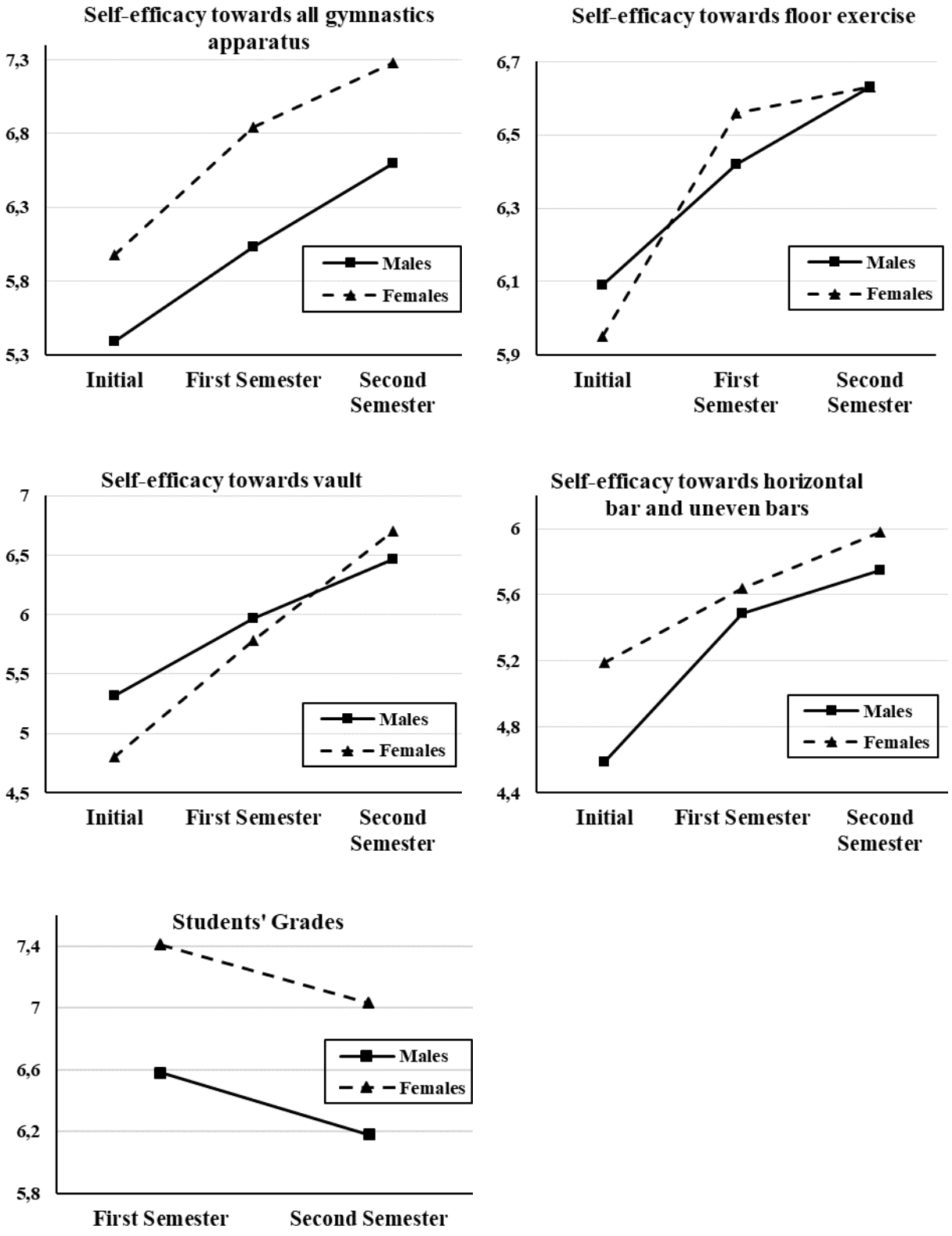

Figure 3. Males' vs. females' self-efficacy towards all gymnastics apparatus, floor exercise, vault, horizontal bar and uneven bars.

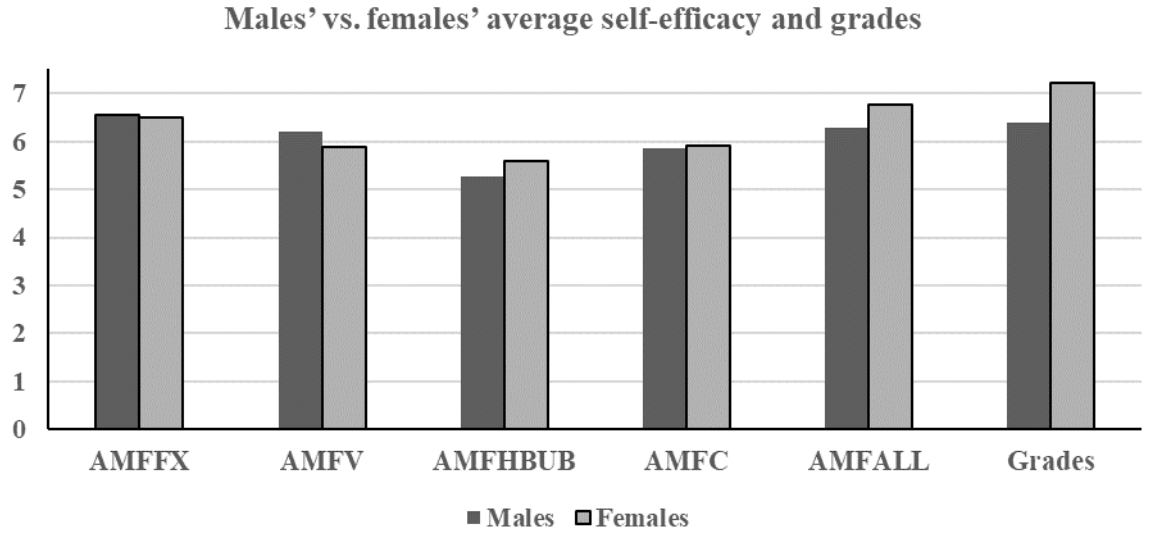

Figure 4. Males' vs. females' average self-efficacy of the three measurements (initial, first, second semester) for the common skills, the total skills on all apparatus (6 for male and 4 for female) and grades (first, second semester).
Abbreviations: AMFFX, average self-efficacy of the three measurements for male and female common floor exercise skills; AMFV, average self-efficacy of the three measurements for male and female common vault skills; AMFHBUB, average self-efficacy of the three measurements for male and female common horizontal and uneven bars skills; AMFC, average self-efficacy of the three measurements for all male and female common skills; AMFALL, average self-efficacy of the three measurements for male and female skills of all apparatus (6 for males, 4 for females); Grades, average grades of the two semesters.

Differences in females' self-efficacy during the academic year

Separate repeated-measures ANOVAs were conducted with students' self-efficacy towards each gymnastics apparatus as dependent variable and time of measurement as the within-subjects factor. Results revealed that there was a significant within-subjects effect for students' self-efficacy towards each gymnastics apparatus (see Table 1): (a) FV, $F(2,318) = 96.30$, $p < .001$, $\eta^2 = .38$, (b) UB, $F(2,318) = 51.26$, $p < .001$, $\eta^2 = .24$, (c) BB, $F(2,318) = 82.58$, $p < .001$, $\eta^2 = .34$, (d) FFX, $F(2,318) = 18.56$, $p < .001$, $\eta^2 = .11$, (e) FALL, $F(2,318) = 144.13$, $p < .001$, $\eta^2 = .48$. Pairwise comparisons revealed that except for the measurements for the second and the third semester for the FFX, females' self-efficacy increased significantly ($p < .05$) measurement by measurement (Table 2, Figure 1).

Teachers' evaluation of gymnastics skills difficulty

Multivariate analysis of variance (MANOVA) was conducted in order to examine differences between the evaluation of male and female skills difficulty by their teachers. Students' gender was the independent variable and teachers' evaluation of the difficulty of gymnastics skills for: (a) the total number of skills of the six males' and four females' apparatus (TMFALL), (b) nine common skills of the floor exercise (TMFFX), (c) the three common skills of the vault (TMFV), and (d) four common skills of the horizontal bar and uneven bars (THBUB) were the dependent variables. Results revealed a significant main effect for gender, Wilks' $\lambda = .152$, $F(4,9) = 12.56$, $p < .001$, $\eta^2 = .85$. Given the significance of the overall test, the univariate main effects were examined. Not significant univariate main effects for gender were obtained for all variables (a) TMFALL, $F(1,12) = .23$, p

= .639, η^2 = .02 (males 6.50 ± 0.98, females 6.75 ± 0.94, mean ± *SD)*, (b) TMFFX, $F(1,12) = .35$, $p = .567$, $\eta^2 = .03$ (6.65 ± 0.75, 6.05 ± 0.71*)*, (c) TMFV, $F(1,12) = 1.22$, $p = .292$, $\eta^2 = .09$ (7.14 ± 1.54, 6.33 ± 1.19*)*, (d) THBUB, $F(1,12) = 2.38$, $p = .149$, $\eta^2 = .17$ (6.18 ± 1.38, 5.82 ± 1.35) (Figure 2).

Gender differences on students' self-efficacy and grades

Repeated-measures ANOVAs were conducted in order to examine gender effects on students' self-efficacy and grades. More specifically, they tested (a) within-subjects effects between the three measurements, (b) between-group differences from first up to the third measurement, and (c) possible differences on the mean of the three measurements between males and females. For the estimation of students' self-efficacy, students' responses were computed to: (a) the total number of skills of the six males' and four females' apparatus (ALL), (b) nine common skills of the FX, (c) the three common skills of the V, and (d) four common skills of the HB and UB (HBUB).

Differences in self-efficacy towards ALL

A repeated-measures ANOVA was conducted with students' self-efficacy towards ALL as dependent variable, time of measurement as the within-subjects factor and students' gender as the between-subjects factor; it revealed that there was a significant within-subjects effect for the total sample, $F(2,359) = 215.41$, $p < .001$, $\eta^2 = .38$, and no significant within-subjects interaction between group (gender) and time of measurement, $F(2,359) = 1.79$, $p = .171$, $\eta^2 = .01$. Inspection of between-subjects effects revealed that there were significant differences between the two groups across all measurements, $F(1,359) = 22.64$, $p < .001$, $\eta^2 = .06$. Subsequent ANOVAs revealed that females had higher overall self-efficacy towards ALL than males' in the initial, $F(1,359) = 14.38$, $p < .001$, $\eta^2 = .04$, the first, $F(1,359) = 24.28$, $p < .001$, $\eta^2 = .06$, and the second semester measurement respectively, $F(1,359) = 17.11$, $p < .001$, $\eta^2 = .05$. Moreover, contrast effects following the within subjects interaction between group and time revealed that from initial measurement to first semester measurement, the self-efficacy towards ALL of females increased more compared to males', $F(1,359) = 4.37$, $p < .05$, $\eta^2 = .01$ (Table 3, Figure 3).

Differences in self-efficacy towards FX

A repeated-measures ANOVA was conducted with students' self-efficacy towards FX as dependent variable, time of measurement as the within-subjects factor and students' gender as the between-subjects factor, revealed that there was a significant within-subjects effect for the total sample, $F(2,718) = 77.38$, $p < .001$, $\eta^2 = .18$, and a significant within-subjects interaction between gender and time of measurement, $F(2,718) = 3.63$, $p < .05$, $\eta^2 = .01$. Inspection of between-subjects effects revealed that there were no significant differences between the two groups across all measurements, $F(1,359) = .000$, $p = .999$, $\eta^2 = .00$. Moreover, contrast effects following the within subjects interaction between group and time revealed that from initial measurement to first semester measurement the self-efficacy towards FX of females increased more compared to males', $F(1,359) = 6.41$, $p < .01$, $\eta^2 = .02$ (Table 3, Figure 3).

Differences in self-efficacy towards V

A repeated-measures ANOVA was conducted with students' self-efficacy towards V as dependent variable, time of measurement as the within-subjects factor and students' gender as the between-subjects factor; it revealed that there was a significant within-subjects effect for the total sample, $F(2,718) = 140.32$, $p < .001$, $\eta^2 = .28$, and a significant within-subjects interaction between gender and time of measurement, $F(2,718) = 8.00$, $p < .001$, η^2

= .02. Inspection of between-subjects effects revealed that there were no significant differences between the two groups across all measurements, $F(1,359) = 1.14$, $p = .286$, $\eta^2 = .00$. However, subsequent ANOVAs revealed that males' self-efficacy towards V in the initial measurement was higher compared to females', $F(1,359) = 9.39$, $p < .01$, $\eta^2 = .03$. Moreover, contrast effects following the within subjects interaction between group and time revealed that from first semester measurement to second semester measurement the self-efficacy towards V of females increased more compared to males', $F(1,359) = 6.48$, $p < .01$, $\eta^2 = .02$ (Table 3, Figure 3).

Differences in self-efficacy towards HBUB

A repeated-measures ANOVA was conducted with students' self-efficacy towards HBUB as dependent variable, time of measurement as the within-subjects factor and students' gender as the between-subjects factor; it revealed that there was a significant within-subjects effect for the total sample, $F(2,718) = 71.40$, $p < .001$, $\eta^2 = .17$, and a significant within-subjects interaction between gender and time of measurement, $F(2,359) = 4.04$, $p < .05$, $\eta^2 = .01$. Inspection of between-subjects effects revealed that there were significant differences between the two groups across all measurements, $F(1,718) = 3.81$, $p < .05$, $\eta^2 = .01$. Subsequent ANOVAs revealed that females' self-efficacy towards HBUB in the initial measurement was higher compared to males, $F(1,359) = 9.39$, $p < .01$, $\eta^2 = .03$. Moreover, contrast effects following the within subjects interaction between group and time revealed that from initial measurement to first semester measurement the self-efficacy towards HBUB of males increased more compared to females', $F(1,359) = 7.61$, $p < .01$, $\eta^2 = .02$ (Table 3, Figure 3).

Differences in students' grades

Frequencies analyses conducted revealed that for the first semester, 10.5% of the males and 1.9% of the females were graded below 5, while 20.9% of the males and 28.1% of the females did not participate in the examinations. Correspondingly for the second semester, 13% of the males and 0.6% of the females were graded below 5, while 37.8% of the males and 35.6% of the females did not participate in the examinations. A multivariate analysis of variance (MANOVA), conducted with students' grades in gymnastics for the first and the second semester as the dependent variables and students' gender as the independent variable, revealed that there was a significant main effect of gender on students' grades, $F(2,201) = 6.21$, $p < .01$, $\eta^2 = .06$. Subsequent ANOVAs revealed significant differences between males and females in average grades for the first semester, $F(1,201) = 11.74$, $p < .001$, $\eta^2 = .05$, and the second semester, $F(1,201) = 9.54$, $p < .01$, $\eta^2 = .04$, with females outperforming males in both cases (Table 3, Figure 3).

Differences in students' average self-efficacy and grades

Multivariate analysis of variance (MANOVA) was conducted in order to examine differences for the average of the three measurements of males' and females' self-efficacy and the grades for the first and the second semester. Students' gender was the independent variable and the average score of their grades (first, second semester) and their self-efficacy measurements (initial, first, second semester) for: (a) nine common skills of the floor exercise (AMFFX), (b) the three common skills of the vault (AMFV), and (c) four common skills of the horizontal bar and uneven bars (AHBUB), (d) the total number of the common skills (AMFC), (e) the total number of skills of the six males' and four females' apparatus (AMFALL), were the dependent variables. Results revealed a significant main effect for gender, Wilks' $\lambda = .619$, $F(5,206) = 25.36$, $p < .001$, $\eta^2 = .38$. Given the

significance of the overall test, the univariate main effects were examined. Significant univariate main effects for gender were obtained for the variables (a) AMFALL, $F(1,210) = 7.30$, $p < .01$, $\eta^2 = .03$ (males 6.27 ± 1.39, females 6.78 ± 1.32, mean ± *SD*) and (b) Grades, $F(1,210) = 12.18$, $p < .001$, $\eta^2 = .06$ (6.38 ± 1.79, 7.22 ± 1.66) and not significant for the other variables (a) AMFFX, $F(1,210) = .74$, $p = .787$, $\eta^2 = .00$ (6.56 ± 1.28, 6.50 ± 1.47*)*, (b) AMFV, $F(1,210) = 2.28$, $p = .132$, $\eta^2 = .01$ (6.19 ± 1.43, 5.89 ± 1.48), (c) AHBUB, $F(1,210) = .74$, $p = .787$, $\eta^2 = .00$ (5.55 ± 1.61, 5.69 ± 1.61), and (d) AMFC, $F(1,210) = .14$, $p = .709$, $\eta^2 = .00$ (5.86 ± 1.36, 5.91 ± 1.45*)* (Figure 4).

DISCUSSION

The aim of the present study was to examine gymnastics specific self-efficacy differences between male and female university students. Results revealed that except for the measurements of the initial and the first semester for the PB and for the first and the second semester for the FFX, students' self-efficacy significantly increased, measurement by measurement, for both genders (Table 1 & 2, Figure 1). These findings are consistent with the self-efficacy theory, according to which mastery experiences provide the most influential source of efficacy information (Bandura, 1986). In the first measurement of the current study, participants had no previous experience with either of the tasks and consequently relied on other sources of efficacy information, as, for example, perceptions of the gender-appropriateness of the task and conception of ability. In line with research findings, during the academic year, as learning progressed, students' self-efficacy increased (Bandura, 1997; Schunk, 1996).

According to Schunk (1996), students enter learning situations with varying degrees of self-efficacy for learning. As they engage in activities, students are affected by personal factors (e.g., goal setting, information processing) and situational influences (e.g., rewards, teacher feedback) that provide them with cues about how well they are learning (Schunk, 1996). Self-efficacy is enhanced when students perceive they are performing well or becoming more skillful (Bandura, 1997; Schunk, 1996) and focus on personal achievements (Maddux, 1995). Lack of success or slow progress do not necessarily diminish self-efficacy if learners believe they know how to perform better, such as by working harder, seeking help, or switching to a more effective strategy (Schunk, 1996). In Figure 1 it appears that females in general tend to have higher self-efficacy beliefs for all gymnastics skill on the 4 women's gymnastics apparatus compared to males (for the 6 men's gymnastics apparatus). It is also shown that males realized that it was easier to perform the skills on FX and more difficult on SR, while females perceived as easier the skills on the BB and more difficult on V.

Results revealed a significant main effect for gender between the evaluation of male and female skills difficulty by their teachers. Although teachers showed a tendency to evaluate as more difficult the gymnastics skills performed on all apparatus (6 for males and 4 for females) for males and the common skills performed on FX, V, and HB/UB for females, examining the univariate main effects did not find significant effects for gender for all variables. Looking at the curriculum, it seems that it includes skills with increasing level of difficulty, and common skills for both genders, as well as skills that could be characterized as more suitable for males (e.g., dynamic skills on SR) or females (e.g., turns, leaps, and jumps on FX and/or BB). However, the non-significant differences regarding difficulty of skills performed on all apparatus that favor females could be explained by the fact that the curriculum includes proportionately easier skills for females compared to males. The evaluation

of male and female skills difficulty by the teachers was in complete agreement with the students' grades based on their performance. Specifically, as shown by the results, females had higher grades compared to males for the first and the second semester. In contrast, the evaluation of the common skills as more difficult for females, by the teachers, is likely, since the common skills are few, with an objectively higher level of difficulty. Furthermore, the successful execution of many of them is based to a decisive degree on strength and speed.

In relation to these results, the examination of students' self-efficacy towards ALL, and common skills on FX, V, and HB/UB, across all measurements revealed the following results. Females had significantly higher overall self-efficacy towards ALL than males' in the initial, the first and the second semester measurement, and for the average of the three measurements. Furthermore, from the initial measurement to the first semester measurement, their self-efficacy increased more compared to that of males. Weitlauf, Cervone, Ronald and Wright (2001) also reported a significant increase in self-efficacy in women attending a voluntary self-defense training program. These findings are contrary to the findings from previous research where males reported higher levels of confidence in a variety of physical skills (Moritz et al., 2000; Rattanakoses et al., 2009; Woodman, & Hardy's, 2003).

The findings of the current study could be explained partially by the fact that, according to teachers' evaluation, females' skills on the 4 women's apparatus included more skills, in general, and many of them were evaluated as much easier compared to the set of skills related to the 6 apparatus of males. Furthermore, although females performed on a fewer apparatus compared to males (4 vs. 6), they performed more skills, including "female" skills (e.g., choreography, dance, turns, jumps, leaps), and this likely resulted in higher self-efficacy. In support, it has been found that females are more confident than males on a feminine type of tasks (Clifton, & Gill, 1994; Lirgg et al., 1996) and on selected physical activities, such as cheerleading, gymnastics, and dance (Eder & Parker, 1987). As supported by recent research (Clifton, & Gill, 1994; Lirgg et al., 1996; Sanguinetti et al., 1985), females do not display a lack of confidence in all situations. It seems that individuals' expectancies for success increase when participating in activities deemed gender appropriate.

Regarding the common skills on FX, there were no significant differences between the two groups, with the exception that from the initial measurement to the first semester measurement, the self-efficacy towards FX of females increased more compared to that of males. However, in the initial measurement, females had not significantly lower self-efficacy than males. The skills "backward roll to handstand" and "salto forward tucked" may have led to this result because those are the skills that need great speed and strength for effective and quality execution.

Considering the common skills on V, there were no significant differences between the two groups across all measurements. However, self-efficacy of males towards V in the initial measurement was higher compared to that of females. Moreover, from the first semester measurement to the second semester measurement, the self-efficacy of females towards V increased more compared to that of males. It is very important to mention that the vault skills were presented (and performed) on the "vaulting horse" (pommel horse, but without handles, placed sideways) for females (it is easier to perform the skills) and on the "vaulting table" for male students. The squat through and the straggle over vault skills were performed using springboard and the handspring using mini trampoline for both

genders. However, to perform well on V requires great speed and strength for effective push down onto the springboard (on foot), and shoulder and hands block onto the vaulting horse/table. This is why males are more likely to perform these skills more easily and efficiently compared to females. Researchers reported that females were less confident than males on this perceived masculine task (Clifton, & Gill, 1994; Lirgg, et al., 1996).

Finally, there were significant differences towards HBUB between the two groups across all measurements. Specifically, females' self-efficacy towards HBUB in the initial measurement was higher compared to males. In contrast, males' self-efficacy towards HBUB increased more from the initial measurement to the first semester measurement compared to that of females. However, there were no significant differences between genders regarding the average of the self-efficacy for the common skills on FX, V and HBUB.

The results of the present study provide support for the arguments that there is a tendency for most gender differences in self-efficacy beliefs to be small and with no clear direction, and that there is a continuum of gender differences as opposed to the simple yes or no answer (Pajares, 2005). As reported by Clifton and Gill (1994), since educational gymnastics includes skills that can be characterized as feminine or masculine, it is possible for male and female students to show similar patterns in terms of self-efficacy beliefs. Furthermore, as educational gymnastics involves students working within their own abilities, both male and female university students may overestimate or underestimate their self-efficacy depending on how they perceive their ability (Milosis et al., 2018).

The findings of the present study should be viewed in light of some limitations. The data for the evaluation of self-efficacy were collected solely from university male and female students and this must be considered before we generalize the results to include students of other levels of education or gymnasts. Furthermore, the current study concerns students' self-efficacy in terms of specific gymnastics skills taught in the course "Didactics of Gymnastics". Expanding the study to include students in other individual or team sports courses may lead to different results, and thus could be an interesting inquiry for future research. The present study did not examine students' perceptions about gender appropriateness of the gymnastics skills included in the curriculum. Such an assessment would to some extent explain the differences found in self-efficacy between genders.

Additionally, it would be beneficial to investigate students' pre-existing implicit beliefs about intelligence, or conception of ability. It has been suggested that pre-existing belief systems, such as implicit theories of intelligence, or conceptions of ability, also exert an influence on self-efficacy beliefs, especially in adults (Jourden, Bandura, & Banfield, 1991). Future studies could also investigate other personality and social factors that influence different types of confidence and sources of confidence, such as the structure of the teaching environment, the academic program, and extracurricular involvement. Next, a qualitative research based on student interviews would also be of interest.

Self-efficacy acts as a cognitive mediator of behavior, including task selection, persistence in the face of barriers, resilience, goal setting and commitment, and effort expended (Bandura, 1997; Bandura, & Schunk, 1981; Locke, & Latham, 1990; Maddux, 1995). It has been shown that is a significant predictor of students' gymnastics performance (Milosis et al., 2018). It has been argued that in order to promote female' self-efficacy, females should be engaged in environments that provide social support (e.g., positive feedback from teammates, encouragement

from significant others, a sense of belonging and control) while allowing them to develop their skills. Females often use self-regulation skills in a learning setting, and they express more confidence in the ability to accomplish tasks.

On the other hand, demonstration of ability (i.e., showing an ability by outperforming others or winning) and satisfaction with accomplishments were significantly more important for the promotion of male athletes' self-efficacy (Vealey et al., 1998). Thus, teachers may need to be intentional with their teaching style when interacting with female versus male students, realizing the potential differences in self-efficacy between the genders. Generally, students gain confidence when they engage in environments structured to be inclusive, supportive of autonomy, challenging, motivating, to provide clear performance evaluation and to encourage self-regulation of cognitions and behavior, skill building, and healthy norms (Dzewaltowski, Estabrooks, Gyurcsik, & Johnston, 2002). Furthermore, by offering student activities that are considered gender-appropriate, they are likely to increase their expectations of success and consequently increase their self-efficacy (Lirgg et al., 1996).

CONCLUSION

Considering the limitations of the present study, the results provide useful information regarding the changes in university students' skill-specific self-efficacy in gymnastics as a consequence of learning during an academic year. These results support the hypothesis that during the academic year, as learning progressed, students' self-efficacy increased because students gained mastery experience and ccould see progress in their performance. In addition, tracking of self-efficacy and performance over a series of sessions may provide useful information about individual students and may help to early identify students that are low in self-efficacy, guide teachers' judgements, and reduce failure rates. Thus, it is critical for teachers to formulate and maintain positive expectations for all students, to develop an inclusive, autonomy-supportive, challenging, and task/mastery-oriented environment, and to encourage self-regulation of cognitions and behavior.

Furthermore, exploring male and female students' gymnastics-specific self-efficacy differences is important for a better understanding of how to better organize and teach a gymnastics course to increase male and female students' self-efficacy beliefs and eventually their performance in gymnastics skills and exercises. Gender differences in competency beliefs influence students' activity choices and participation and should be considered when studying achievement. Therefore, it is crucial for teachers to convey to students that the gender appropriateness of skills is socially constructed, not based on biological factors, and that gymnastics skills are developed through deliberate practice. By doing so, students may be encouraged to attempt a variety of skills, which, in turn, may positively influence their beliefs about what they are truly capable of achieving. Teachers must cultivate student's beliefs in their capabilities, while at the same time create conditions for the desired success to be achieved since it is usually easier to weaken self-efficacy beliefs through negative appraisals than to strengthen such beliefs through positive encouragement.

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DETECTION OF EATING DISORDERS IN MALE AND FEMALE ARTISTIC GYMNASTS

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Abstract

The purpose of this study was to investigate the trend of eating disorders in competitive male and female artistic gymnasts. The study involved 23 male and 42 female gymnasts, aged 7-27, from sports clubs throughout Greece. The EAT-26 Diet Attitudes scale was used to investigate participants' eating habits. The data collection process included communication with sports organizations throughout Greece on the content and purpose of the research. After consultation, the questionnaire was due to the COVID-19 pandemic provided in an electronic form and also included the consent form for participation in the research. The results of the study indicated that eleven of the sixty-five gymnasts had a total score of >20 on the EAT-26, a rate higher among female gymnasts (~ 24%) compared to male gymnasts (~ 4.4%) ($p < .05$). Although female gymnasts develop more eating disorders and bulimia than male gymnasts, no significant differences were found in the subscales of the questionnaire ($p > .05$). Therefore, this finding in combination with the fact that most of the gymnasts were teenagers (15.23 ± 6.35 years old) requires particular importance and attention from coaches and the family environment.

Keywords: *Eating disorders, Artistic gymnastics, Aesthetic sports, Puberty, Neurogenic anorexia, Neurogenic bulimia, Covid-19.*

INTRODUCTION

The term eating disorder defines the definitive disorder of eating habits and control of body weight that, as a result, may cause clinically significant damage to the health and psychosocial behavior of the individual (Sudi et al., 2004). Psychogenic anorexia and bulimia nervosa are the most extreme manifestations of eating disorders; however, some factors such as food or diet obsession, lack of satisfaction with body image, and constant weight gain are associated with divergent eating behavior (Michou & Costarelli, 2011). These symptoms are caused by psychological and emotional factors (Weinberg & Gould, 1995), more specifically, low self-esteem, feelings of hopelessness, negative self-esteem, and anxiety in relation to weight and body shape (Heywood & McCabe, 2006). Since the beginning of the 21st century, the prevalence of eating disorders seems to play an important role both in the general population and in the field of high-performance sports (Clark, 2007). In more recent years, eating disorders have progressively become more frequent in female population, and specifically in sports (Hausenblas & Carron, 1999; Swoap & Murphy, 1995). The main eating disorders are classified into the following categories of pathological conditions: a) "psychogenic-neurogenic anorexia", b)

"psychogenic-neurogenic bulimia" and c) "atypical eating disorders" (Michou-Costarelli, 2011).

The competitive profile of aesthetic sports such as artistic (AG) and rhythmic gymnastics (RG) predisposes mainly female gymnasts to a constant preoccupation with their shape, size and/or body weight (Dallas, Dallas, Simatos, Simatos, 2016). Further, the vast majority of gymnasts engaged in such sports attempt to maintain the "perfect" physical appearance, which is characterized by low total body mass and low-fat mass throughout their sporting career (Beals, 2004), generating an increased association of eating disorder (Kerr, Berman, De Souza, 2006; Krentz & Warschburger, 2011; Nordin, Harris & Cumming, 2003). In aesthetic sports (AG & RG), environmental factors (coaches, parents, judges) put constant pressure on young gymnasts to maintain a slim body (Salbach, Klinowski, Pfeiffer, Lehmkuhl, & Korte, 2007), since low body weight is associated with high quality performance (Sample, 2000). Low body weight meets the "aesthetic" requirements of sports (Thompson & Sherman, 2010) mainly in RG where it appears that there are higher indicators in the tendency for a slim body and the incidence of eating disorders in comparison to AG and acrobatic gymnastics (AcG) (Nordin, Harris, & Cumming, 2003).

The incidence of eating disorders (EDs) in athletes of different sports (21%) and level of performance is higher than in non-athletes (6%) (Byrne & McLean, 2001; Hausenblas & Carron, 1999). In addition, the diagnostic criteria for subclinical and clinical EDs were met by more athletes (13.5%) than controls (4.6%, $p < .001$) and by more female (20%) than male athletes (8%, $p < .001$) (Sundgot-Borgen & Torstveit, 2004), while in sports that have strict criteria for controlling body weight - either as a condition of performance or ranking or as a subjective assessment by judges, such as AG and RG, indicate much higher rates of EDs (Cook & Hausenblas, 2011; Smolak, Murnen, & Ruble, 2000). Factors such as training volume, unusual eating practices and reduced food intake, contribute to the occurrence of eating disorders (Monthuy-Blanc, Maiano, & Therme, 2010). Moreover, low self-esteem and body dissatisfaction appear to be determinants of the occurrence of eating disorders in the general population (Jacobi et al, 2004). Self-esteem is an imperative predictor of various disorders in adolescence and adulthood and its lacking contributes to poor body image (Gleason, Alexander, & Somers, 2000) and is associated with both the occurrence of eating disorders (Milligan & Pritchard, 2006) as well as constant preoccupation with dieting and lack of satisfaction with the physical image. Body image refers to the perceptions, feelings and thoughts that a person experiences regarding their shape, body size and appearance, while lack of satisfaction with body image is considered an important factor in the occurrence of eating disorders (Kato et al. 2011).

Defamatory comments about the body or instructions for weight loss create a tendency for disturbed eating habits (Kerr et al, 2006) and higher rates of negative emotions, for instance, shame and anxiety (Muscat & Long, 2008). It is estimated that up to 40-45% of elite athletes in "aesthetic" sports show symptoms of eating disorders (De Souza et al., 2014; Francisco, Alarcao, & Narciso, 2012). The importance of this research lies in the fact that the developmental age of adolescence is a critical and sensitive period for the occurrence of eating disorders, especially in gymnastic sports (Sundgot-Borgen & Torstveit, 2004), as well as for their subsequent maintenance in the future. Hence, the purpose of this study was to investigate the occurrence of eating disorders in competitive male and female artistic gymnasts, and look at gender differences in eating attitudes as well.

METHODS

Forty-two competitive female gymnasts, aged 7-27, with a mean age 15.04 ± 5.8 years and a mean training experience 8.61 ± 5.31years ; and twenty-three male gymnasts, aged 7-27 (13.78 ± 5.1), with a mean training experience 8.14 ± 4.32 years, volunteered to participate in the study. The present research was carried out in sports clubs of Greece during the months of January to August 2021. The 65 questionnaires were collected from sports clubs throughout Greece. The response rate of athletes amounted to 78% of the total number of gymnasts in the aforementioned clubs. (Initially, the questionnaire was sent to a much larger sample of gymnasts. However, a number of questionnaires was poorly answered and therefore not considered for statistical analysis). The body height and body weight of the participants were self-reported (information was collected in the survey) and the demographics of the gymnasts (age, gender, sport, education, competitive experience, training frequency) were collected in the survey and completed by gymnasts and/or their parents. The body mass index (BMI) (kg/m^2) of the athletes was calculated according to the known mathematical formula weight / $height^2$; on this basis, the average and the standard deviation for the anthropometric characteristics were calculated. The procedures were approved by the Institutional Ethics Review Committee of the National and Kapodistrian University of Athens.

To identify potential eating disorders and evaluate gymnasts' eating behaviours , the following questionnaire was used: The Eating Attitude Test EAT-26 (Garner, Olmsted, Bohr and Garfinkel, 1982) is an eating attitudes test that has been validated for use in the Greek population (Douka, Grammatopoulou, Skordilis, Koutsouki, 2009). It is a leading diagnostic evaluation marker for the early identification of subclinical cases of disordered eating behaviour. This scale was constructed to record the symptoms, behaviours, and thoughts associated with eating disorders. In addition to the single factor "eating attitudes" (26 questions in a 4-point Likert-type scale), the questionnaire includes 3 separate sub-scales dealing with: slimming diets (dieting), bulimia and pre-occupation with food, and oral control. The total score of EAT-26 is obtained by summing up the total number of sentences that make it up with a special scoring key, while the score of each factor is obtained by summing up the score of individual questions that make it up. Overall performance of ≥ 20 at EAT-26 indicates abnormal eating behaviour and appearance of symptoms of disordered food intake. However, this questionnaire is not utilised to diagnose eating disorders; rather, it is designed to detect a possible onset or pre-existing eating disorder. Subsequent confirmatory factor analysis of the questionnaire (Douka, Grammatopoulou, Skordilis, & Koutsouki, 2009) resulted in a questionnaire consisting of 13 questions with three factors (diet, bulimia and food).

After consultation of the researcher with the sports clubs, the coaches were informed over the phone and in written form about the content and purpose of the research. Due to the pandemic, they were given the questionnaire in electronic form. It included the consent form for participation in the research which had to be completed and signed by the gymnasts themselves (if they were adults). Prior to the study, the gymnasts, their parents and coaches were fully informed about the purpose and procedures of the study and gave their written informed consent. For underage children, a prerequisite for participation was to send digitally parental consent . In addition, a cover letter was sent digitally to participants, parents-guardians, and coaches, stating that their participation was voluntary, they were not at any type of risk; it informed them of the importance and purpose of the study, and the confidentiality and anonymity of the

data collected. Participants were given a written reminder that all questions had to be answered by choosing the option that represented them, including a hint that there were no right or wrong answers. The questionnaire was completed by the parents / guardians of underage participants.

Statistical analysis was performed with SPSS v. 22 (SPCC Inc., Chicago, IL) and the level of statistical significance was set at .05. After the preliminary check, it was found that the basic statistical assumptions were met and that the variables had an approximately normal distribution. Initially, descriptive statistics indices (means and standard deviations) were used for all variables under consideration. In order to examine the differences between the two groups in anthropometric characteristics and in all examined variables, a t-test was performed between independent samples. The Pearson r correlation coefficient was used to investigate the correlations between the variables in question. The Cronbach alpha was used to examine the internal consistency across three age groups (children, adolescent, adults). The results revealed coefficients ranging from .297 to .567, and may be found in Table 1.

Cohen (1988) limits were used to determine the intensity of the statistically significant correlations. Specifically, if r <.29, the correlation is considered weak, if .30 <r <.39 is considered moderate, if .40 <r <.69 is considered strong, and finally, if r> .70, the correlation is considered very powerful.

RESULTS

Descriptive statistics of anthropometric characteristics as well as body mass index (BMI) and training experience are presented in Table 2.

Of the 42 gymnasts who participated in the study, 10 scored > 20, of which four were aged 12-17, three 8.5-11 and three 24-25. Of the 23 athletes, only one scored > 20 (aged 19 years). Means and standard deviations of gymnasts' scores for both genders in EAT-26 scale as a whole as well as in the individual factors (diet, bulimia and food, swallowing control) are listed in Table 3.

Table 1
Internal consistency across age groups.

Group	Cronbach's Alpha
Diet	
Total	.567
Children	.438
Adolescent	.422
Adults	.438
Bulimia	
Total	.297
Children	.287
Adolescent	.463
Adults	-.181
Oral control	
Total	.432
Children	.034
Adolescent	.381
Adults	.730

Furthermore, the total sample was categorized according to their total score in EAT -26 as well as depending on gender (Table 4).

In addition, correlations between the subscales of the EAT 26 are presented in Table 5.

Table 2
Anthropometric characteristics, body mass index and training experience of the sample (n = 65).

	Male gymnasts (n=23)	Female gymnasts (n=42)	Total sample (n=65)
Age (years)	13.78 ± 5.10	15.23 ± 6.35	14.72 ± 5.98
Weight (kg)	47.88 ± 18.73	42.7 ± 13.26	44.53 ± 15.61
Height (m)	1.53± 0.18	1.49 ± 0.14	1.515 ± 0.15
Body Mass Index (BMI) (kg/m^2)	19.53 ± 3.51	18.69 ± 3.1	18.99 ± 3.28
Training experience (years) *	8.61 ± 5.31	8.14 ± 4.32	8.31 ± 4.70

Table 3
Gymnasts score in EAT -26 scale.

Parameter	Male gymnasts (n=23)	Female gymnasts (n=42)	Total sample (n=65)
Engagement with diet	5.52 ± 4.57	7.07 ± 4.65	6.6 ± 4.62
Bulimia & Engagement with food	2.43 ± 1.50	3.45 ± 2.65	3.14 ± 2.35
Oral Control	2.33 ± 2.21	2.57 ± 2.53	2.5 ± 2.4
EAT-26	9.8 ± 6.9	12.09 ± 7.46	11.9 ± 7.73

p > .05

Table 4
Categorization of the sample (n = 65).

Categorization of the sample according to the total score in EAT-26		
Total score	Frequency	%
>20	11	16.92
<20	54	83.07

Categorization of male and female artistic gymnastics athletes according to the total score in EAT-26				
	Male athletes (n = 23)		Female athletes (n = 42)	
Total score	Frequency	%	Frequency	%
>20	1	4.35	10	23.91
<20	22	95.65	32	76.19

Table 5
Pearson correlation between subscales of EAT 26 (n = 65).

	diet	Bulimia	Swallowing control
Dieting	1	. 440 **	. 771 **
Bulimia	. 440 **	1	. 481 **
Oral control	. 771 **	. 481 **	1

p < .01

DISCUSSION

The majority of scientific studies referring to eating disorders are mainly focused on female population as it is more prone to eating disorders compared to males. Therefore, the purpose of this study was to investigate the tendency of eating disorders in competitive male and female artistic gymnasts. Subsequently, the differences in dietary attitudes of the male gymnasts compared to female gymnasts was examined. Further, a Pearson correlation that was conducted to reveal the correlation between the subscales of EAT 26 verify data by Thomas, O'Hara, Tahboub-Schulte, Grey, Chowdhury (2018) who found positive correlation among these subscales.

Results showed that the overall score in EAT-26 was 12.1 (7.1 on the diet subscale, 3.5 on the bulimia subscale and 2.6 on the swallowing control subscale) and 9.8 (5.5 on the diet subscale, 2.4 on the bulimia subscale and 2.3 on the oral control subscale) for female and male gymnasts, respectively. Accordingly, female gymnasts scored higher overall on the EAT-26 Eating Attitudes Scale as well as on individual values in the Diet and Bulimia and Eating categories. Nevertheless, no significant differences were revealed between male and female athletes on the subscales of the questionnaire (p > .05). Further, a few non-significant differences were found between children and adolescents in our study (p > .05), as opposed to Hadjigeorgiou et al. (2018) who found significant differences between different age groups, in both men and women, as young and middle adulthood scored higher when compared to adolescence.

Our findings differed from those of Gonidakis et al. (2008) who examined 33 athletes from various sports (wrestling, track & field, gymnastics, and martial arts) and discovered that the total score on the EAT-26 questionnaire was 8.6, revealing lowers scores on the diet and bulimia subscale (3.3 and 1.7, respectively) in contrast to the higher score (3.6) on swallowing control. Furthermore, our results demonstrated that female gymnasts are more susceptible to developing eating disorders compared to male gymnasts. The high percentage (15.4%) of female athletes with a score greater than 20 showed that there is a worrying tendency in the occurrence of eating disorders in the sport of artistic gymnastics. This is consistent with previous data (Theodorakou & Donti, 2013) which showed that 9 out of 30 female athletes had a score higher than 20 in EAT-26, and those of Sundgot-Borgen & Torstveit (2004) who found high incidence of eating disorders in athletes of aesthetic sports. Respectively, the research of Martinsen and Sundgot-Borgen (2013) found that 19.7% of female athletes were more likely to develop an eating disorder

during adolescence compared to non-training individuals.

Participation in gymnastics/aesthetic sports is often associated with strict control of body weight, as a slim and lean body is a prerequisite for performance, ranking and positive evaluation by judges. Meeting the requirements of aesthetics sports (Thomson & Sherman, 2010) is associated with high incidence of eating disorders in these sports (Cook & Hausenblas, 2011; Smolak, Murnen & Ruble, 2000). Therefore, the results of the present study emphasize the importance of athletes' performance level as 11 of the 65 athletes scored more than 20.

However, certain limitations do not allow for generalization of the present findings without considerable caution. A primary limitation is that the data were collected by using questionnaires. Although this method is widely accepted in psychological research, researchers do not have the ability to monitor responses. Regardless, this data collection technique does not appear to affect the validity of the results (Pate, 1993). Another limitation is the wide range in the age groups of the sample, as well as the number of participants (n = 65), and that measurements of anthropometric characteristics were conducted by the participants. Likewise, apart from the calculation of the body mass index, no other measurements were performed (eg., fat measurement). This restriction is particularly important as it does not provide information on participants' lean body mass. The main reason for the small number of participants was that the present study was performed under pandemic conditions. Consequently, all clubs were closed and it was difficult to communicate properly with the managers and coaches. In addition, the present study is original not only because it was conducted during the pandemic but also because it was an attempt to detect eating disorders not only in female but also in male gymnasts from different clubs. In addition, a limitation of the study was that it involved only artistic gymnasts; the main reason was to detect EDs in this aesthetic sport in which both sexes participate and is characterized by dynamic exercises performed on different apparatus with different structure. Finally, a limitation which should be mentioned is that this particular study was performed during the pandemic confinement of COVID-19. This means that the information of the gymnastics clubs and coaches was made over the phone and the questionnaires were distributed electronically. Therefore, there was no direct contact and interaction with the participants, which means that any questions and clarifications about the process were not possible. The results of the study will lead to new findings, adding to the issue that has not been studied enough and directly concerns not only gymnasts' performance but also their health. Thus, the importance of research lies in the fact that the developmental age of adolescence is a critical and sensitive period for the occurrence of eating disorders, especially in gymnastics/aesthetics sports. However, further research should aim to examine differences in more detail, between gymnasts from different branches of gymnastics, such as trampoline, rhythmic gymnastics, acrobatic gymnastics, etc. In addition, eating disorders in non-aesthetic sports, such as martial arts, contact sports, and team sports, can be investigated. Given the limitations of the present study, future research is needed to investigate larger and more homogeneous samples of gymnasts, to investigate the existence and frequency of eating disorders. Finally, it is deemed necessary to repeat the present research once the pandemic is behind us.

CONCLUSIONS

Results of the present research led us to the following conclusions. Initially, the results of the study indicated that eleven of the 65 participants (16.9%) had an overall

score> 20 at EAT- 26 and no gender effect was found in EAT-26. More specifically, ten of the 42 female gymnasts (23.91%) scored > 20, while only one of 23 male gymnasts (4.35%) had a total score > 20. Similarly, in the individual dimensions of EAT-26, Diet and Bulimia and food, female gymnasts showed higher values. Consequently, female artistic gymnasts seem to be a high-risk group for eating disorders.

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IMMEDIATE EFFECT OF MENTAL SIMULATION ON SELF-CONFIDENCE AND PERFORMANCE WHEN PERFORMING STANDING SALTO BACKWARDS IN GYMNASTS

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Abstract

The aim of this study was to examine the combined effect of mental imagery as well as visualization on performance, self-confidence, and self-report during the performance of the standing salto backward. Eighteen gymnasts (age 22.11 ± 1.71 years) voluntarily participated in this study. Once the warm-up was completed, subjects performed a standing salto backward tucked on the force-plate to determine the baseline performance before each experimental session. Subsequently, subjects were given specific intervention instructions and were asked to perform the standing salto backward tucked to the best of their ability. Participants were asked to engage in two mental strategies namely mental imagery and visualization for 1 min just before performing (Standing salto backward tucked). The results of the present study show that the combined mental simulation (MI and V), generate a potential improvement in performance during the execution of the standing salto backward as well as self-confidence and self-evaluation.

Keywords: *gymnastics, standing salto backward tucked , mental stimulation, mental imagery, visualization, self-confidence, self-evaluation.*

INTRODUCTION

Sport psychology activity is the scientific study of people and their behavior to improve athletic performance (Weinberg & Gould, 1997). The determining factors of athlethe's come from the environment. However, "the sporting actors in the world" attach little importance to thoughts, personality, and perceptions. So, it is interesting to have knowledge in psychology; it allows coaches and athletes to take a step back, analyze real-life situations, understand any dysfunctions and remedy them, and find psychological methods intended to develop mental qualities (Bui-Xuan, 2000).

Thus, to promote the virtues of sports psychology among coaches and athletes, many dedicated professionals have reflected on the contributions that practitioners can bring to the sporting world. Hence, the notion of mental preparation is now considered to be a determining factor in athletic performance. This phenomenon is more prominent in individual sports (e.g., tennis, judo or fencing, etc.) that have shown an interest in this new discipline.

Featured in the work of Feltz and Landers (2007) and Orlick and Partington (1988), mental training, alongside physical, technical, and tactical training, contributes immensely to improving performance in various disciplines. Fournier (1998) also indicates that mental preparation is a preparation for competition by learning mental and organizational skills to optimize the athlete's personal performance.

As a physical activity, gymnastics is a reproduction of an activity; it is also a production of created or codified gestural forms. It engages a complex expressive body motor that is habitual and controlled to produce a sequence in a particular environment that is judged and appreciated. This rich body language creates situations of acrobatic mastery of gymnastics. However, it is also possible that the features of the movement (duration, complexity, nature of the constraints of the task) may lead the athlete to form clear mental images, which is why we associate the mental timing parameter with mental imagery during learning of a gymnastic sequence in order to appreciate the evolution of performance (Denis & Boucher, 1991; Féry, 63 2003; Hardy & Callow, 1999; White & Hardy, 1998).

Indeed, mental preparation focuses on the learning techniques and strategies allowing the athlete to progress and better manage his performance mentally, emotionally, and physically (Tod, 2005). Moreover, mental simulation consists of internally repeating the movement before performing. Theorists assume it improves motor skills and motor learning (Feltz & Landers, 1983; Deschaumes-Molinaro et al., 1991).

Strategies used by athletes typically include imagery, attention, and preparatory excitement. These strategies are designed to increase physical and mental activation, concentration, and self-confidence (Brody, Hatfield, Spalding, Frazer, & Caherty, 2000). Many sports psychologists have been interested in the mental preparation employed by the athlete immediately before sports performance (Geiger et al., 1999; Weinberg, Jackson, & Seaboune, 1985). Athletes believe that these strategies will lead to better performance and will allow them to lift heavier loads (Tod et al., 2003).

However, qualitative research perceives imagery as a strategy that helps athletes better overcome negative symptoms and facilitates better athletic performance (Hanton, Mellalieu, & Hall, 2004). For example, elite gymnasts, according to Hanton et al., 2004, described how imagery allowed them to maintain a positive attitude and to interpret the anxiety-triggering factors in a positive way.

Thus, mental imagery is used by athletes to regulate anxiety, reduce poorly adapted behaviors, reduce negative thoughts, and increase concentration (Richardson, 1967a, 1967b; Feltz & Landers, 1983; Suinn, 1993; Mumford & Hall, 1985).

Research on the means to be implemented to improve sports performance report two main uses of mental images based on goals, different methods and means. Indeed, mental images are used, on one hand, in the learning of motor skills, and on the other hand, in the mental preparation of athletes. (Rushall & Lippman, 1998).

In addition, one of the most effective mental preparation techniques in the field of sport is visualization. "Visualization, like mental imagery, is a technique that implements the resources of the mind, imagination, and intuition to increase one's well-being". (Murphy & Jowdy, 1992). In this sense, imagery is scientifically defined as a cognitive practice that consists of evoking the characteristics of an object, event or process absent from our current perceptual field.

It is the ability to think in pictures that can be learned. It will allow the gymnast to acquire new technical elements, to correct and strengthen them, and to prepare for

and manage competitions by recalling symbolic images (Warner & McNeill, 2013).

Visualization is therefore a powerful tool for improving performance, recovering faster, optimizing athlete's time, and at the same time increase his concentration and motivation. Whether in the sporting, technical, medical, or musical field, visualization is a powerful and useful tool (Warner & McNeill, 1988).

Elements that will influence the effectiveness of such a practice are precision, correct visualization of movement, frequency of practice, and association with real movement (Warner & McNeill, 1988). The gains are therefore greater if we combine sessions of precise and detailed visualization with well-conducted workouts. The association of visualization with training therefore provides more gains than training alone (Lebon, 2010).

Many gymnasts struggle with performing up to their potential in competition. Research indicates that psychological factors such as concentration, confidence, motivation, and anxiety have a significant impact on performance in sports and may lead to athletic performance deterioration (Morrow, Jackson, Disch, & Mood, 2000). In some cases, these factors can be critical to success in sports, particularly at the highest levels. Mental training is important in artistic gymnastics, since gymnasts face ever increasing difficulty demands required by the international Code of Points from an early age. To meet these requirements, gymnasts should be willing to put in a high level of physical effort as well high level of mental concentration to perform the technical elements of this sport (Nassib et al., 2014).

Gymnastics is a complete sport; it develops musculature, coordination, self-control, concentration, and mental skills. There is a direct link between gymnastics and cognitive function. A recent study (Jemni, 2011) proved that gymnastic exercise requires agility training, circuit training, coordination, and other intense physical skills that can dramatically impact cognitive markers. These include reasoning skills, verbal communication, spatial ability, and inductive reasoning. All these mechanisms are specific to cerebral activities that determine a person's overall cognitive health. They also impact a person's attention, learning, and memory skills (Caine, Russell, & Lim, 2013).

However, in gymnastics, very few studies have examined. the effect of mental practice on performance and no research has been conducted on execution of acrobatic elements.

Thus, the purpose of this study was to assess the combined effect of mental imagery and visualization on performance, self-confidence and self-evaluation while performing the standing salto backward tucked. More precisely, to determine if there was a positive transfer from visual modality (visualization) to proprioceptive modality (imaging) that would increase the precision of the technical element.

METHODS

Eighteen male gymnasts (age 22.11 ± 1.71 years; height 1.73 ± 0.06 m; mass 68.65 ± 5.65 kg; experience 10.2 ± 1.7 years) volunteered to participate in this study. They were all undergraduate students pursuing licence degrees in Exercise Science and Physical Education at the University of Manouba, Tunis (Tunisia). Their average experience in gymnastics was 10.2 ± 1.7 years and the average of their weekly training was between 6-8 hours. Before the experiment, none of the subjects had ever specifically performed mental stimulation with the aim of improving motor performance. The participants were divided into two counterbalanced and randomized groups as follows:

- Mental imagery group (MI)
- Visualisation group (V)

They received detailed instructions to perform specific mental skill strategies with precision and efficiency. The principles of anonymity and volunteering have been guaranteed to subjects before the start of the experiment. They were informed of the sole use of data for scientific research purposes.

The experimental protocol of the current study was approved by the Ethical Committee of the ISSEP Ksar Saïd of the research unit "Analysis and evaluation of factors determining the sports performance". All participants read and signed informed consent forms in accordance with research ethics. To ensure good reproducibility of test results and reduce the effects of learning, athletes were asked to avoid high-intensity physical training for 24 hours before testing. This was to prevent residual fatigue from interfering with the test performance.

Pre-experimental procedure

Before the experiment, all participants completed the *Sport Imagery Questionnaire* which assesses the vividness of images (visual, kinesthetic, auditory imagery) generated to be able to subsequently incorporate the imaging condition into our experimental protocol.

Additionally, they completed the *Vividness of Visual Imagery Questionnaire* (VVIQ) that assesses the ability of subjects to see imagery with their eyes open and closed. The questionnaire VVIQ2 on the vividness of imagery and " Sport Imagery Questionnaire Hall and Martin (1997)" were explained item by item by a specialist. Once all the items in the questionnaires were explained, subjects were asked to answer the questions by choosing the response they felt that best corresponded to their situation. Participants who read and received standardized instructions for completing the questionnaire were informed that their responses were confidential. Throughout the process, standardized instructions were given to subjects and verbal encouragement was provided to help them perform to the best of their ability.

The experiment consisted of two phases, followed by a final debrief. The first phase was a familiarization phase, and the second phase included experimental sessions. During the familiarization period, metric measurements of gymnasts (weight and height), the duration of gymnastics practice per week and per day were collected. Then, the questionnaires were filled in in the presence of the researcher to overcome any difficulties encountered. No information on the purpose of the study was provided to participants until the end of the sessions. No psychological intervention was applied during this period. The participants were also asked to avoid physical effort during the experimentation period to prevent injuries and fatigue.

Before the experiment, the gymnasts were given the same breakfast, consisting of juice, a cake, and a bottle of water; this was maintained throughout the experimental period to guarantee the same test conditions and neutralize the nutritional effects on performance. The different experimental sessions were carried out at the same time of the day for each subject (11a.m.-1p.m) and under standard environmental conditions (23 ± 1 ° C and 41 ± 2% relative humidity) to avoid diurnal variations.

The participants attended 2 experimental sessions, 24 hours apart, to perform the standing salto backward tucked. The participants engaged in Visualization (V) during the 1st session and in Mental Imagery (IM) during the 2nd session. The interventions were counterbalanced and randomized to avoid any learning effect.

The combination of these strategies aims to produce a positive transfer of visual modality

(Visualization) which provides visual information about the movement being performed to the proprioceptive modality (Imaging) which consists of mentally

simulating action to increase the precision of gestures.

Upon arrival, the subjects began a standardized general warm-up of 5 minutes of moderate intensity running. This was followed by movement exercises and specific muscular actions. The warm-up exercises were inspired by the specific warm-up used in acrobatics in artistic gymnastics (Robe, 2006). Once the warm-up was completed, the subjects performed a standing salto backwards tucked on the force-plate to determine the baseline performance before each experimental session. Then, the subjects received specific instructions and were asked to perform again the standing salto backward tucked the best they could. At the end of the experiment, the participants completed the Self-Confidence Scale.

Post-experiment interview:

To check whether the subjects performed the experimental conditions in accordance with the instructions, subjects were asked to describe the cognitive strategies used.

Measures

Performance

The standing salto backwards tucked is a backward rotation passing in front of the center of gravity around an axis. During the standing salto backwards tucked, one should regroup, grab the legs, and finish in standing position.

Movement analysis:

- Dynamic and complete leg pulse.
- Launched-blocking of the arms.
- Grouped knees-chest-heels-buttocks.
- Grouping.

To analyze the movement of the standing salto backwards tucked, two AAE high-definition video cameras PNJ Cam 120 Hz were used to record in 2D each test of all subjects. These recordings were later used in the analysis of each of these trials. These high-definition devices record executions so that they can be analyzed later. The participants were scored according to the criteria described in the FIG Code of Points (2017).

The standing salto backwards tucked performances were recorded using a force-plate equipped with piezoelectric sensors and connected to a computer equipped with the "Quattro Jump" software which provides, from the personal information of each subject, quantified data and graphics. All sessions took part in the same room and with the same researchers.

To avoid unmeasurable work, horizontal and lateral displacements were minimized during the tests. The participants performed standing salto backwards tucked from the standing position. For pre-test measurements, the standing salto backward tucked results were determined. The subjects involved in this study were instructed to react as fast and jump as high as they could to immediately execute the standing salto backward tucked. Two trials were performed with 1-minute active rest between the attempts.

Two attempts were recorded for each subject: the 1st performance before any psychological intervention (base performances), and the 2nd performance after the engagement in the mental preparation technique specific to each group. In addition, a scorecard was designed to evaluate standing salto backwards tucked (Table 2), with a maximum score of 2 points [very good (2 pts); good (1.5 pts); medium (1 pts); low (0.5 pts) for each variable]. Three national judges assessed all students during the experiment.

Salto Rear Scoring System (Table 1).

- Small fault 0.25 pts (deflection / flexion angle less than 15°).
- Average fault 0.5 pts (deflection / flexion angle greater than or equal to 15° and less than 30°).
- Gross fault 1 pts (deflection / flexion angle greater than or equal to 30° and less than 45°).
- 2 pts fall (from the apparatus or on the apparatus).

• 16 pts technical and 4 pts held, i.e., a score out of 20 pts.

Mental strategies

Mental imagery (MI)

Each gymnast imagines performing the standing salto backwards for a minute while trying to improve performance. . The instructions given to the subjects in this group were based on the personal information data obtained from the questionnaire. The gymnasts were asked to close their eyes or keep them open. Then, they were asked to watch their movement or feel their body in space or listen to the noise related to the movement in their head.

The correct execution of this condition was checked by the researcher in a post-experiment interview to ensure the subjects performed the experimental condition according to the instructions. Subjects were asked to describe the nature of imagery after the intervention (Gould, Weinberg, & Jackson, 1980; Cumming, Olphin, & Law, 2007).

To generate and then control the mental work, an imagery script was given to participants (Tod et al., 2003; Whelan, Epkins, & Meyers, 1990):

"You have 1 minute during which I would like you to visualize yourself carrying out sprints as fast as possible. Please close your eyes and imagine achieving a new personal record".

Visualization (V)

Once the baseline performance was determined, the subjects were requested to visualize individually a video presenting their basic performance (standing salto backward tucked) for 1 minute. The video had been projected so that the movement was well known to the subject. During this strategy, an external modality was used. There was a frontal take of the movement made by the participant, followed by another in profile, in real time, and then in slow motion. The video did not contain any sound effects and/or written instructions to ensure that attention was paid to the movement only.

The experimenter had to remove any disturbing elements from the environment by giving the subject the following instruction before starting the video:

" In front of you, you have a one-minute video that you need to watch carefully for maximum performance". No verbal instructions were given to subjects during the viewing.

Sport Imagery Questionnaire: (SIQ)

Before carrying out the study, the vividness of the participants' images was assessed to determine the sharpness and richness of the mental images generated to be able to subsequently incorporate the Imaging into our experimental protocol. To do this, we used the Sport Imagery Hall Questionnaire (Hall & Martin, 1997). SIQ is widely used in psychology and applied to sports; its validity and reliability was demonstrated by Kamel-Rateb (2007). This questionnaire was used as a measure of the ability of visual, auditory, and kinesthetic imagery. As part of this study, the calculation of the internal coherence coefficients (Cronbach's alpha) = 0.88 with the interval of 95% confidence: [0.79-0.94] allowed the control of the psychometric qualities of the tool used (Munroe-Chandler, & Hall, 2016).

This questionnaire measures the abilities of athletes to experience different senses, emotions, and perspectives during imaging. The SIQ refers to four common experiences in the sport: practicing alone, practicing with others, watching a teammate, and performing in a competition. After doing the imagery for a minute, including each of these experiences separately, the subject must then estimate the vividness and sharpness of the mental images on a five-point Likert scale ranging from 1 point "no image present" to 5 points "Image perfectly sharp, as precise and lively as a real perception".

In the present study, the SIQ was used to measure the individual imaging capacity based on the measures most used and most recommended by many authors (Hardy, Jones, & Gould, 1996). However, only the visual modality of mental imagery was considered in this research.

Participants were invited to complete a questionnaire in a quiet location and in standardized conditions. The literature points out that, thanks to its ease of administration and rapidity of analysis, in addition to its good validity and reliability (Childers, Houston, & Heckler, 1985; Rateb, 2007), this is a "good example" of measuring individual's mental imagery capacity.

Self-confidence

The self-efficacy questionnaire (SEQ) was used to assess the perceived trust of each participant (Mills, Munroe & Hall, 2000). The SEQ is made up of five items that ask the participant to write down the strength of their belief in their mental abilities based on a 100-point scale, with 10-unit intervals ranging from 0 (no confidence) to 100 (full confidence). Mental abilities measured by this questionnaire include concentration, control, and mental toughness. More precisely, the five items are: "I am confident of being able to work in difficult situations"; "I am confident I can stay focused for a long time in difficult situation ";" I am confident that I can be mentally strong throughout a competition"; "I am confident that I can maintain control in challenging situations"; and "I am confident in being able to appear confident in front of others". The SEQ presented internal consistencies with an alpha level of .86 (Munroe-Chandler, Hall & Fishburne, 2008).

Self-evaluation

Self-evaluation is a process by which a participant makes a judgment on the quality of his progress, his execution, or his achievements regarding predefined objectives (Legendre, 2005). Thus, at the end of the experimental session, a self-evaluation grid was administered to assess how the subjects perceived their performance. The performance of standing salto backward tucked was judged by the participants with an evaluation score of 1 to 20. This was to encourage participants to analyze what they achieved and how they were doing.

Data are reported as mean ± standard deviation. Before using the parametric tests, normality of the distribution was verified by the Shapiro–Wilk W-test. Data was analyzed using repeated measure analysis of variance (ANOVA) to examine the difference between performance before and after using mental strategies (MI / V). When the effects were not significant, ANCOVA was used to compare the base performance with performance after mental strategies. When significant effects were present, a Bonferroni test was performed to determine the differences in pairs. The changes expressed in percentages were calculated [(IM V) / V * 100]. Significance was set at 0.05% ($p \leq 0.05$). Calculations and statistical analyses were performed using the Statistical Package for the Social Sciences version 20.0 (SPSS Inc., Chicago, IL, USA).

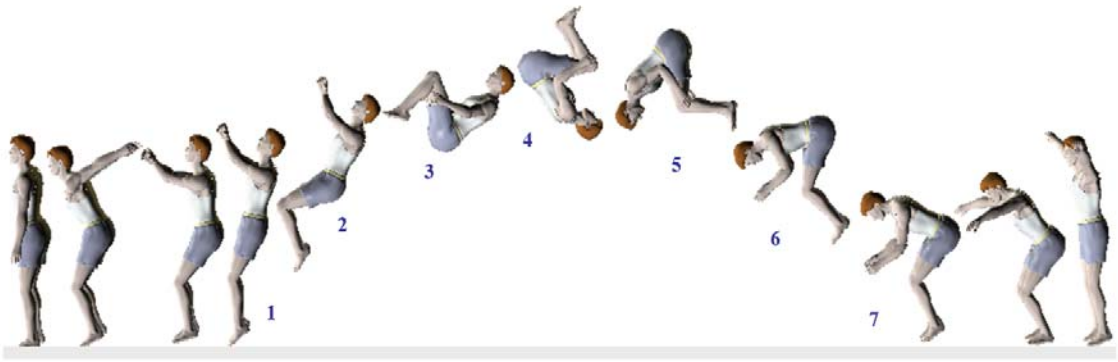

Figure 1. Standing Salto Backwards Tucked (Mkaouer, 2013).

Table 1
Execution Criteria of Assessment.

Score	Take-off		Grouped		Off grouped		Landing	
	Take-off angle (°)	Trunk/Leg ang (°)	Trunk/Leg ang (°)	Thigh/Leg ang (°)	Vertical displacement (m)	Trunk/Leg ang (°)	Horizontal displacement (m)	Stability (step/fall)
Excellent (2 pts)	80 – 90°	185 – 190°	46 – 50°	76 – 90°	≥ 0.50 m	165 – 175°	On the spot	Stick 0 step
Small Error (1.5 pts)	70 – 79°	191 – 195°	41 – 45°	61 – 75°	0.41 – 0.49m	145 – 164°	0.10 – 0.2m	1 small step
Medium Error (1 pts)	60 – 69°	196 – 200°	36 – 40°	46 – 60°	0.31 – 0.40m	125 – 144°	0.21 – 0.30m	1 big step
Large Error (0.5 pts)	< 60°	201 – 205°	30 – 35°	30 – 45°	0.20 – 030m	100 – 124°	> 0.30m	Several steps

Table 2.
ANCOVA (repeated measures ANOVA with covariance with baseline performance).

Variables	df	Mean square	F	Sig.	Partial eta squared	Power
With Mental Simulation	1	0.872	5.312	0.05	0.431	0.511
Without Mental Simulation	1	0.650	3.959	0.087	0.361	0.405
Training	1.737	50.186	12.556	0.001	0.611	0.976

Table 3
Changes in means expressed in %.

	Mean	Std. Deviation	N
IM_Perf_(N/20)	13.277	1.655	9
V_Perf_(N/20)	12.722	1.986	9

[(IM-V)/V*100] = 6.14 %

Table 4. Correlation between self-confidence assessment results and self-assessment results, after training without mental strategies.

	Performance without mental stimulation	***Self-confident***
Self-confident	-0.709*	---
Auto-evaluation	0.452	0.889**

(*) Significant at $p \leq 0.05$; (**) Significant at $p \leq 0.001$.

Table 5. Correlation between self-confidence assessment results and self-report results after visualization training.

	Performance	***Self-confident***
Self-confident	-0.759*	---
Auto-evaluation	0.118	0.680*

(*) Significant at $p \leq 0.05$

RESULTS

Execution results

This present study examined the combined effect of mental imagery, visualization of performance, self-confidence and self-evaluation on the standing salto backward tucked. More precisely, the study aimed to determine if there was a positive transfer from visual modality (Visualization) to proprioceptive modality (Imaging) on increasing the precision of the execution.

The results of ANCOVA (repeated measures ANOVA with covariance with baseline performance) are described in detail in Table 2.

In addition, the interaction between the imaging and the visualization simulation methods showed a significant result ($F = 8.46$, $p \leq 0.05$). A post hoc analysis (Bonferroni test) showed a significant difference at $p<0.05$.

Regarding the simulation method, the analysis revealed that mental imagery as well as visualization had an important effect, with an improvement of 6% by switching from the imagery method to visualization (see Table 3).

Psychological results

Correlation between self-confidence results and self- evaluation after training without mental strategies showed a negative correlation between the results of self-confidence performance (%)and performance without mental imagery (N / 20) (see Table 4). Moreover, our results show a positive and significant correlation between the results of self-evaluation (N / 20) and confidence (%) (see Table 4).

For training with visualization, results showed a negative and significant correlation between the results of self-confidence (%) and performance (cm). In addition, results showed a positive and significant correlation between the results of self-evaluation (N / 20) and self-confidence (%) (see Table 5).

DISCUSSION

This study aimed to investigate the influence of mental strategies (IM and V) on performance (standing salto backward tucked) and on self-confidence in gymnasts. The present findings highlighted the importance of mental preparation

strategies and their potential effects on improving physical and psychological performance. A statistical analysis of the repeatable ANCOVA, which was carried out on the average of performances, found a significant effect of the simulation intervention ($F = 5.31$; $p < 0.05$), while the baseline performance (without mental stimulation) had no significant increase ($F = 3.95$; $p > 0.05$). Indeed, this improvement in performance (standing salto backward tucked) resulted in better execution with segmental coordination on the force platform. Mental strategies (MI and V) have an important role in improving performance. Specifically, a repeated measure ANOVA analysis was performed to determine whether there were any main effects or significant interactions on each of the performance dimensions, hence a significant effect noted on the performance ($F = 12.55$; $p < 0.001$).

The Richardson's (25) neuromuscular feedback theory demonstrated that a vivacious and focused image produced muscle activation comparable to that observed in actual motion. When mental simulation is sufficiently high it can generate proprioceptive feedback used to enhance the corresponding motor program. Brody et al. (2000) suggested that mental strategies might lead to changes in motor unit recruitment within the muscle. Specifically, it was hypothesized that there could be an increase in motor unit activation in the agonist muscle and a decrease in motor unit activation in the antagonist muscle. Self-directed cognitive strategies or psyching up do likely occur in the cerebral cortex. Therefore, psyching up may stimulate changes in the activity of the central nervous system (CNS), resulting in adjustments in motor unit recruitment, or synchronization, or muscle firing rate, or all. Similarly, changes in the CNS may modify the sympathetic nervous system activity, which may result in alterations in peripheral factors, like muscle contractility (Bray, Seed, Cluff, & Seed, 1994).

In studies of Feltz and Landers (1983), Orlick and Partington (1988), and Gow, Tuffey, Hardy, and Lochbaum (1993), it has been shown that mental training, along with physical, technical, and tactical training, contributes enormously to improving performance in various disciplines. A study of Thelwell and Maynard (2003) and Hanton, Wadey, and Connaughton (2005) indicated the importance of mental skills in the achievement of sports performance. MI and V improved the physical performance of subjects. Therefore, these results are aligned with those demonstrated by Jones, Hanton, and Swain (1994). They have proven that the development of effective coping strategies and preparation through mental imagery to eliminate parasitic thoughts are all elements favoring the emergence of neutral perceptions or favorable to performance. In addition, qualitative research shows that imaging is a better strategy helping athletes overcome negative symptoms and facilitates better performance (Hanton & Jones, 1999a,1999b).

Regarding the simulation method, our analysis revealed a significant effect of mental imagery as well as visualization ($p < 0.04$, $p < 0.01$; respectively), and an improvement of 6% when switching from the imagery method to visualisation. Therefore, the immediate effect of the two strategies on standing salto backward tucked is better performance. This improvement is thanks to the combined effect of the two effective modalities (MI and V). At the same time, combining visualization and imagery with training results provides more gains than training alone (Lebon, 2009).

It should be noted that to develop power, movement must be done quickly or explosively, because this causes the nervous system to recruit the maximum number of muscle fibers in the minimum time (Brody *et al* 2000). Along with these physiological explanations that show that improved muscle power comes first from

the controls of the nervous system, research on the relationship of cognitive techniques with nerve controls and muscle changes has been developed.

According to this research, cognitive techniques can stimulate changes in the activity of the central nervous system (CNS), resulting in adjustments in the activation of motor units, synchronization and / or rate of involvement of these units (Bray et al., 1994; Brody *et al* 2000). Likewise, these studies support that those changes in the CNS may alter the activity of the sympathetic nervous system which affects muscle contractility.

Although these results suggest that cognitive techniques affect the cerebral, nervous and mycological structures at the origin of the control of muscle power, we note the multitude of phenomena acting on this quality. It is therefore likely that improving lower extremity muscle power through cognitive techniques strategies would require more sessions than those spent during the present study, given the complexity of developing this quality.

Concerning improving psychological performance, these self-managed strategies used by gymnasts could ensure the best improvement in athletes' self-confidence. Indeed, statistical analysis of correlations between performance and self-confidence indicated that after using mental strategies, there were more positive and significant correlations between self-evaluation, self-confidence score, and the standing salto backward tucked in comparison to the performance without mental training strategies.

CONCLUSION

The aim of the current study was to investigate the ability of gymnasts to engage in (visual and spatial) mental imagery and visualization, and the effects of this ability on enhancing athletes' performance of standing salto backward tucked . The study contributed to the exploration of mental imagery, supplying an added support for psychological effects of mental imagery and for its practicality in motor and sport sciences. Initially, it was found that the combined effect of the two strategies (MI and V) improved performance in comparison to the baseline performance. Second, self-confidence and self-evaluation are statistically proven to be better after using these strategies. Apart from the reduced number of sessions in the present study, the improvement is strongly present and the effects of imaging and visualization on performance and on self-confidence are observed following the combined effect of two strategies. The initial hypothesis that mental preparation strategies have potential effects on improving physical and psychological performance, as claimed in previous studies, is thus confirmed.

The hypothesis suggesting that these strategies could ensure an improvement in self-confidence of athletes based on the results of previous research is validated. In addition, the present research highlights the role played by mental strategies in mobilizing cognitive, mental (self-confidence) and physical (performance) resources. In addition to the pursuit of better physical performance, the mental state is a pillar of success and optimization of performance. Mental strategies can improve slightly the initial potential of psychological performance (self-confidence). This fact seems to us of major importance for the preparation of athletes in difficult situations that threaten their confidence and their ability to succeed. Among mental techniques, we distinguish IM and V for their potential to improve self-confidence.

This research is useful to physical, mental, and athletic trainers, and provides them with information on how to optimize performance. Although the findings do not provide definitive conclusions, they bring more interest to the subject of MI and V in sports preparation. Future research should include a greater variety of gymnastic

elements analyzed, especially more complex ones.

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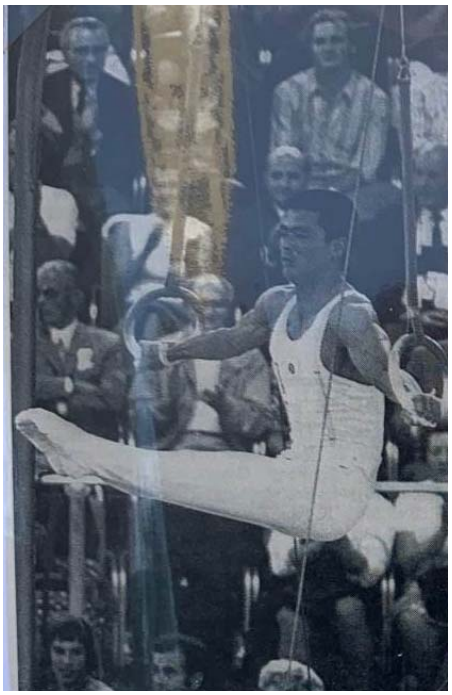
SHORT HISTORICAL NOTES XXV

Anton Gajdoš, Bratislava, Slovakia

Ph.D. Anton Gajdoš born on 1.6.1940 in Dubriniči (today Ukraine) lives most of his life in Bratislava (ex TCH, nowadays SVK). He comes from gymnastics family (his brother Pavel have world championship medals) and he devoted his life to gymnastics. His last achievement is establishment of Narodna encyklopedia športu Slovenska (www.sportency.sk). Among his passion is collecting photos and signatures of gymnasts. As we tend to forget old champions and important gymnasts, judges and coaches, we decided to publish part of his archive under title Short historical notes. All information on these pages is from Anton's archives and collected through years. Short historical Notes XXIII were written in collaboration with Michal Bábela, PhD.

Shigeru KASAMATSU (July, 16, 1947, Kumano, Japan)

Shigeru Kasamatsu started gymnastics at the age of ten, what in his time was something normal. He started with all around aparatus training later at junior high school. At Chunichi Cup (the most traditional Japanese international competition) in 1970 e finished second in the all-around what was his biggest success, As this was still time of Sawao Kato and his teammates, who dominated world gymnastics. In Munich 1972 at OG he was a member of the Japanese team which won a fourth consecutive Olympic team gold. Kasamatsu placed fifth in the all-around, third on floor and horizontal bar, and second on parallel bars.

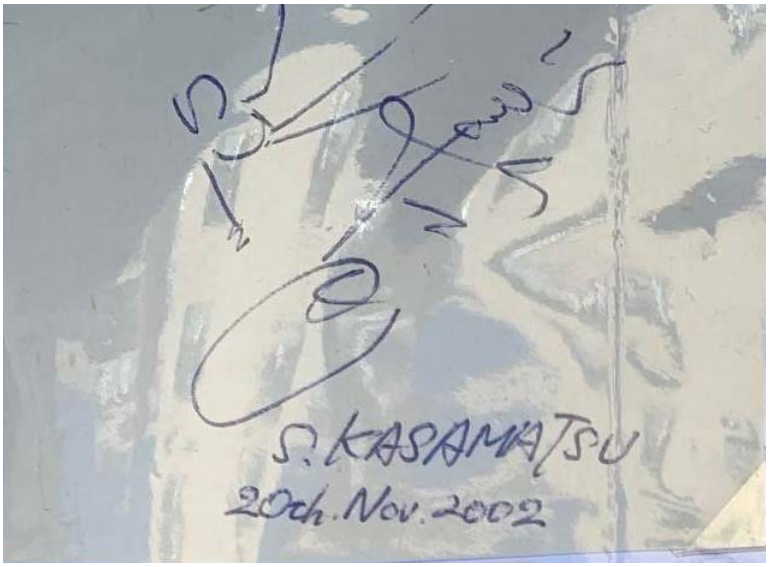


The 1974 World Championships in Varna (Bulgaria) where his best competition ever. He won the all-around and also won gold in floor, horse vault, and with the team. Four gold medals made him the most succesfull gymnast in Varna.

He was one of those guys, whoo have lack of luck, while he was dominating in world of gymnastics. He missed OG 1976 in Montreal because of appendectomy. Unfortunately he missed OG in time when he was in the best ages to win not only all around, but also some apparatus.

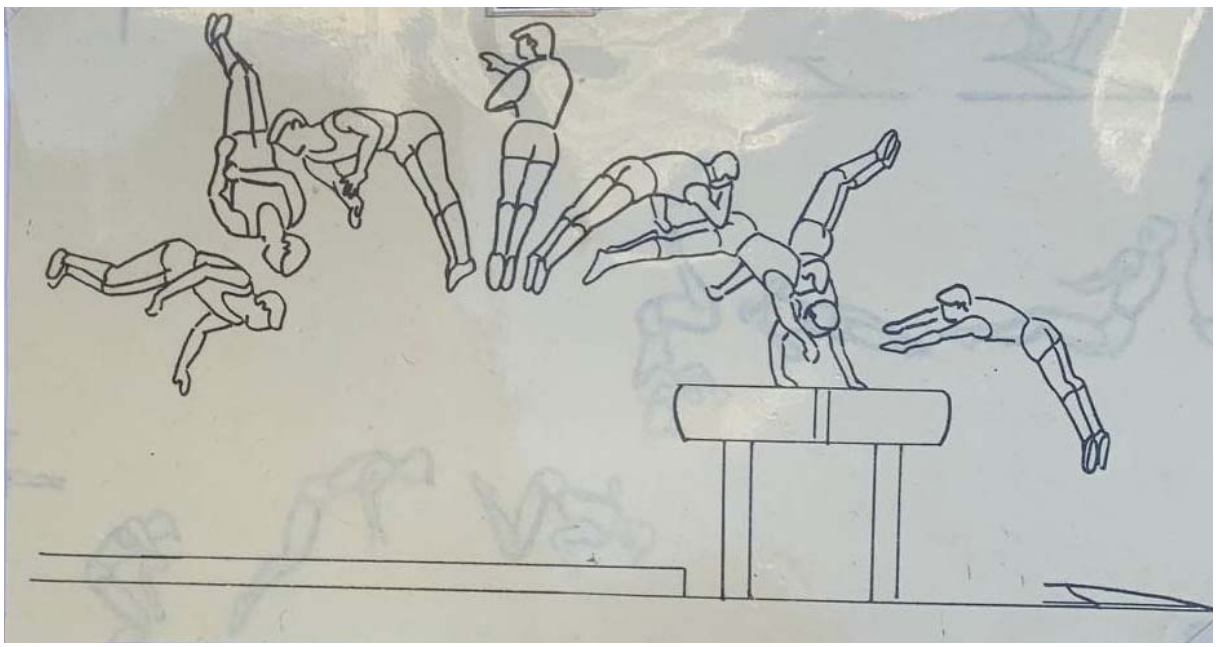
His return to the world stage in 1978 at WC in Strasbourg was succesfull, but not as mush before operation. With team he won team gold, gold on horizontal bar and silver on floor.

At the 1979 World Championships at Forth Worth he was memeber of Japonaise team, which placed the second, and for Japan it was the first time after five consecutive wins between 1962 and 1978 they lost team title.



His family is also gymnastics orientated, as his wife Kazue Hanyu competed in two Olympics (1968 and 1972) and their son Akihiro Kasamatsu competed in the 2000 Olympics.

Shigeru Kasamatsu is not in our history only because of his great results, but also becuse his creativity, as he was the first gymnast who performed on vault jump – carthwheel with 90 degres turn onward and salto stretched forward with 270 degrees turn. In Code of Points by FIG his vault is todaj even more developed, as gymnasts are adding more and more turn.



He was inducted into the International Gymnastics Hall of Fame in 2006.

Slovenski izvlečki / Slovene Abstracts

VPLIV NAČINA ODRIVA NA KINETIČNE IN KINEMATIČNE ZNAČILNOSTI PRI SKOKU PREDNOŽNO UPOGNJENO, ZANOŽNO Z METOM IN LOVLJENJEM ŽOGE PRI RITMIKI

Akkari-Ghazouani, H., Mkaouer, B., Amara, S., Jemni, M., Chtara, M.

Raziskava primerja kinetične in kinematične dejavnike skoka prednožno upognjeno, zanožno z in brez metanja žoge s sonožnim odrivom v ritmiki (R). V raziskavi je sodelovalo sedem članic tunizijske vrste R (starost 18,71±2,69 let; višina 1,67±0,04 m; teža 58,43±4,03 kg). Kinetična in kinematična analiza treh načinov izvajanja skoka je bila izvedena (tj. skok brez žoge, skok z metom žogo in ujemom v letu, skok z metom žoge in ujemom pri doskoku) z uporabo dveh kamer ob tekmovalni preprogi, v kateri je bila pritiskovna plošča. Navpični vektor sile, hitrost razvoja sile, kot med nogami ter vodoravna in navpična hitrost odriva se značilno razlikujejo ($P<0,01$). Med izvajanjem skoka z metom v letu predstavljajo najvišjo vrednost tako kinetičnih kot kinematičnih parametrov med skokom. Glede na dobljene rezultate je priporočljivo, da ritmičarke pričnejo izvajati ta skok z metom že od najmlajših let, saj bi tako lahko dosegli najboljše tekmovalne dosežke.

Ključne besede: zalet, odriv,met, doskok.

VPLIV VADBE "RITMIKA ZA PREDŠOLSKE OTROKE" NA KULTURO GIBANJA PRI 5-6-LETNIH OTROKIH

Lilia Honchar, Giurka Gantcheva, Yuliia Borysova, Nina Kovalenko

Obstoječi izobraževalni načrti za predšolske otroke ne upoštevajo gibalne kulture kot sestavine razvoja otrokove splošne kulture. Pri pouku telesne vzgoje in zdravja v predšolskih izobraževalnih ustanovah se veliko pozornosti posveča količinskim kazalcem, ki označujejo gibalne sposobnosti. Učitelji posvečajo manj pozornosti tehniki in lepoti izvedbe gibanja. Namen raziskave je poskusno potrditi učinkovitost načrta "Ritmika za predšolske otroke" na gibalno kulturo otrok, starih 5-6 let. V razsikavi je sodelovalo 80 otrok, ki so bili razdeljeni v 2 skupini, poskusno in nadzorno skupino, v vsaki po 40 otrok. Učinkovitost "Ritmike za predšolske otroke" je bila določena na podlagi različnih rezultatov v vsakem dejavniku pred in po poskus v vsaki skupini. Otroci v nadzorni skupini so izboljšali rezultate. Vendar to povečanje ni zanesljivo ($p> 0,05$). Gibalne sposobnosti so se izboljšala pri vseh otrocih v poskusni skupini, vendar ne pri vseh sposobnostih ter pri vsakem otroku. Pisci se strinjajo z običajnim na okvirom »kulture gibanja«. Vadba "Ritmike za predšolske otroke" je učinkovito orodje za razvoj gibalne kulture predšolskih otrok.

Ključne besede: telesna pripravljenost; gibalna kultura; telesna pripravljenost; lepota gibanja

.

OPIS NAČRTA ZA RITMIČARKE ZAČETNICE: PORAZDELITEV OBREMENITVE IN VPLIVI NA DOBRO POČUTJE

Shauane Emanuela Fornaciari Silva, Martina Bernaciková, Lenka Svobodová, Marcela Janíková, Helio Serassuelo Junior, Ana Carolina Paludo

Opis strukture načrta vadbe in merjenje odziva na količino vadbe začetnike na znanstveni ravni v virih še vedno ni pojasnjeno. Namen je bil opisati načrt vadbe ritmike za začetnice in preučiti njihovo dojemanje obremenitve in dobrega počutja pri vadbi. Osem brazilskih ritmičark (10,6 ± 0,5 let) iz določene šole je sodelovalo v poskusu, ki je trajal 26 tednov in je bil razdeljen na splošno pripravo (1), ritmično pripravo (2), povečano intenzivnost vadbe (3), pripravo na tekmovanje (4).), tekmovanje (5) in po tekmovalno (6) obdobje. V vsaki vadbi sta bila dobro počutje in notranja vadbena obremenitev (ITL) izmerjena z Likertovo lestvico. Primerjava dobrega počutja in ITL med programom je bila opravljena s testi ponovljenih meritev, s pomembnostjo $p< 0,05$. Ugotovljena je bila pomembna razlika v ITL med obdobji ($x2= 110$, $p<0,001$), pri čemer so obdobja 3, 4 in 5 predstavljale višje vrednosti v primerjavi z 2 in 6. Obdobje 6 je imelo nižji ITL v primerjavi z 2. Višje vrednosti dobrega počutja so bile opisani med vadbo, vendar je 6. obdobje v primerjavi z 2. in 5. obdobjem dala znatno višji rezultat ($x2= 12,0$, $p=0,018$). Na koncu se zdi, da je načrt vadbe ritmike, razvit za učence začetnike, ustrezen glede strukture in porazdelitve obremenitve pri vadbi. Poleg tega, da ritmičarke poročajo o boljšem splošnem počutju med programom, je treba pozornost nameniti tekmovalnemu tednu, da se izognemo poslabšanju počutja in možnim negativnim učinkom na uspešnost.

Ključne besede: vadbena obremenitev, športna šola, dodatne dejavnosti.

TELESNE ZNAČILNOSTI MLADIH RITMIČARK GLEDE NA PREHRANSKO VEDENJE STARŠEV

Burcu Uslu, Begum Okudan, Ezgi Bozdemir, Müveddet Emel Alphan

Ritmika je šport, ki je podprt z močjo, hitrostjo in vzdržljivostjo s poudarkom na gibljivosti in koordinaciji. Predpostavlja se, da nizek odstotek maščobe, normalna višina, nizka telesna masa ter uglajena in vitka struktura vplivajo na uspešnost športnic, saj zagotavljajo lepotno prednost v tej športni panogi. Namen raziskave je bil razkriti telesne lastnosti pri ritmičarkah ter preučiti spremembe in razmerja teh spremenljivk glede na prehrano njihovih staršev. Za zbiranje podatkov je bil uporabljen vprašalnik z družbenimi in prebivalstvenimi podatki »Parental Feeding Style Questionnaire«. Vključeni so bili tudi podatki o ITM otrok, obsegu pasu in nadlakti; vse te meritve je izvedel isti raziskovalec. Ugotovljeno je bilo, da se rezultati, pridobljeni na lestvici načinov hranjenja staršev, razlikujejo glede na obseg pasu otroka ($p <0,05$). Sklepamo lahko, da se rezultati, dobljeni na lestvici starševskega načina hranjenja in njenih podrazsežnosti spodbujanja k prehranjevanju/spodbujanja hranjenja in instrumentalnega hranjenja razlikujejo glede na otrokov zgornji srednji obseg roke ($p <0,05$). Kot rezultat raziskave se zdi, da nekatere družbene in telesne značilnosti vplivajo na način prehranjevanja otrok pri starših. Rezultati, pridobljeni s to študijo, se lahko uporabljajo kot vodilo pri ustvarjanju v prihodnost usmerjenih prehranskih modelov za otroke, ki se ukvarjajo z ritmiko, in načrtovanju prehranskega izobraževanja za njihove starše.

Ključne besede: ritmika, telesne značilnosti, prehrana, starši

BALET IN RITMIKA: RAZMISLEKI O TEHNIKI IN UPORABI V ŠPORTU

Vanessa Pizzol, Mateus Henrique de Oliveira, Kizzy Fernandes Antualpa, Eliana Toledo

V svoji zgodovinski poti je ritmika (R) nastala pod vplivom švedske telovadbe, plesa in gledališke umetnosti, saj je danes šport, za katerega je značilna močna umetniška in lepotna privlačnost. Besedilo se začne kot področna študijska raziskava, želi prinesti podatke, predvsem pa razmišljanja o tem, kako so bili razredi klasičnega baleta zasnovani in uporabljeni pri vadbi visokozmogljivih ritmičark. Gre za raziskavo, s kakovostnim in kkoličinskim pristopom. Vzorec je sestavljalo devet udeležencev (vaditeljev in/ali inštruktorjev baleta), ki delajo s športnicami v mlajših in višjih kategorijah v državi São Paulo, z udeležbo na državnih prvenstvih. Vprašalnik je bil izveden v času od 1. do 15. maja 2018. Podatki so pokazali, da so najbolj uporabljene baletne metode kraljeva, vaganova, francoska in kubanska; da struktura pouka vključuje takt in zaključevanje ter da je načrtovanje pouka baleta sodelovalno. Glavni cilj te vadbe je učenje in izboljšanje izvajanja baletnih gibov v Pravilniku za ocenjevanje FIG (CoP), zato so vsebine večinoma višje cenjene prvine gibanja celega telesa. Ugotovljeno je bilo, da še vedno obstaja kopičenje nalog (vaditelj in baletni inštruktor v eni osebi), močan vpliv CoP v vadbenem načrtu klasičnih baletnih ur, kar žal krepi veliko uporabo te vadbe, ne glede na njene značilnosti kot umetnost ter njene ustvarjalne, ritmične, lepotne in izrazne vidike.

Ključne besede: usposabljanje; klasični balet; ples; balet za ritmiko.

NOV MERSKI POSTOPEK SKLADNOSTI GIBANJA RITMIČARK

Josipa Radaš, Elena Milenković, Lucija Milčić

Ritmika je mešanica športa in umetnosti, pri kateri igra sposobnost skladnosti gibanja zelo pomembno vlogo. Ker ni dovolj posebnih merskih postopkov, ki bi ocenjevali skladnost gibanja, tako pri izboru otrok za ritmičarke, kot tudi pri spremljanju uspešnosti vadbe, je glavni namen tega prispevka izdelava novega merskega postopka, ki se bo posebej uporabljal za ritmiko. V vzorec je bilo vključenih 93 študentov 3. letnika sočasnega dodiplomskega in podiplomskega študija Kineziološke fakultete Univerze v Zagrebu (povprečna starost 21 ± 1 leto). Poleg novokonstruiranega merskega postopka »Echappe« s kolebnico (MKEV) so bili uporabljeni še okretnost na tleh (MAGONT), skoki v obroč naprej (MKOOPO) in premagovanje ovir nazaj (MREPOL). Za lažjo pripravo in predstavitev podatkov je bil uporabljen Microsoft Excel 365, medtem ko je bil za statistično analizo uporabljen IBM SPSS Statistics 26 z aritmetično sredino in standardnim odklonom kot opisnimi indikatorji, Shapiro-Wilksov test za določanje normalnosti porazdelitve, Kruskal-Wallisov test z Bonferronijevim popravkom za veljavnost in Fleiss Kappa za določanje zanesljivosti, ki je bila nadalje določena s Spearmanovo rang korelacijo. Rezultati so pokazali, da ni dokazov, da "Echappe" z vrvjo meri skladnost gibanja, potrebno za uspeh v ritmiki, in da so potrebne nadaljnje raziskave z drugačnimi merili, ki bodo prispevali k izboljšanju metričnih značilnosti merskega postopka.

Ključne besede: gibalni razum, merske značilnosti, ritmika, "Echappe"

UPORABA VADBE S POVEČEVANJEM UPORA PRI MLADIH TELOVADKAH OLIMPIJSKIH UPIH

Michael M. Lockard, Tynan F. Gable

Telovadke v mladinski olimpijski kategoriji (JO) so zelo pripravljene in običajno vadijo 8–20 ur na teden. Vadba je pogosto sestavljena iz številnih ponavljajočih se dejavnosti s telesno maso z malo spremenljivosti. Pri tej metodi vadbe manjka povečevanje napora (PRE), ki je temelj za mišično prilagoditev. Cilj je bil preveriti učinek 10-tedenske vadbe PRE, 1 dan/teden, na mišično silo in moč pri JO. Sodelovalo je 50 deklet, starih 7-17 let (povprečno 10,2±2,7 let), ki so tekmovale na stopnjah JO 3-10. Telovadke na stopnjah 3 in 4 JO so bili razdeljeni v nadzorno skupino ali skupino PRE. Nadzorna skupina je nadaljevala običajno vadbo brez PRE. Skupina PRE je opravila predpisano PRE vadbo. Telovadke stopnje 5-10 so prav tako opravile PRED vadbo. Opravljenih je bilo 15 vadbenih enot. Preizkusi za moč spodnjega in zgornjega dela telesa so vključevali navpični skok in prilagojeno meritev Wingate za roke in ergometer (Arm-WanT). V primerjavi z nadzorno skupino je skupina PRE imela večji napredek v navpični moči ($p=0,003$). , in Arm-WanT največjo moč in srednjo moč ($p=0,044$ in 0,023), vendar ni razlike v Arm-WanT indeksu utrujenosti. Telovadke v stopnjah 5 do 10 so podobno izboljšali navpično moč (2224±756W na 2473±688W, $p<0,001$), največjo moč Arm-WanT (80,9±30,1W na 93,2±40,6W, $p<0,001$) in srednjo moč (62,8) ±23,2 do 70,1±27,3, $p<0,001$), brez spremembe indeksa utrujenosti Arm-WanT. 10 tednov PRE bo izboljšalo moč zgornjega in spodnjega dela telesa pri otrocih in mladostnikih.

Ključne besede: pliometrija; atletska uspešnost; vadba z obremenitvijo

.

KAKOVOST ŽIVLJENJA, STOPNJA OBČUTKA STRAHU IN STOPNJA POTRTOSTI MED BIVŠIMI TELOVADCI IN DRUGIMI ŠPORTNIKI TER NEŠPORTNIKI

Koralli Dimitriadou, Costas Dallas, Sotiris Papouliakos, George Dallas

Vključevanje ljudi v telesno dejavnost ali šport prinaša nekatere koristi, povezane z zdravjem, in pozitivno vpliva na njihovo kakovost življenja (QoL). Vendar se športniki na visoki ravni bojijo spoprijeti z visokimi zahtevami športa. Namen raziskave je bil oceniti QoL, stopnjo občutka strahu (STAI) in stopnjo potrtosti (BDI) med nekdanjimi telovadci, nekdanjimi športniki drugih telovadnih športov (akrobatske, ritmika, skupinske akrobatske sestave) in nešportniki. Namen je bil tudi ugotoviti obstajajo razlike med spoloma znotraj skupin glede zgoraj omenjenih spremenljivk. V pričujočo raziskavo je bilo vključenih 114 zdravih ljudi (75 žensk in 39 moških) s povprečno starostjo 27,11 ± 9,92 let. Merjenci so bili razdeljeni v 3 različne skupine (1. skupina: 39 nekdanjih telovadcev (FAG); 2. skupina: 53 nekdanjih telovadcev drugih telovadnih športov (GOS) in 3. skupina: 22 nešportnikov (CG). Udeleženci so bili pozvani, da izpolnite tri različne vprašalnike, ki so ocenili njihov QoL, STAI in BDI. Statistična analiza ni pokazala pomembnih razlik pri QoL in STAI, ne glede na to, ali je bila ugotovljena statistično pomembna razlika med skupinami pri BDI ($p <,05$). Glavnega učinka ni bilo, nekdanji telovadci, ne glede na vrsto športa imajo boljši QoL, nižjo raven STAI in BDI v primerjavi z nešportniki.

Ključne besede: kakovost življenja, strah, potrtost, telovadci

RAZLIKE V SAMOUČINKOVITOSTI IN USPEŠNOSTI ŠTUDENTOV GLEDE NA SPOL V TELOVADBII

Dimitrios C. Milosis and Theophanis A. Siatras

Namen raziskave je bil preučiti razlike med študenti in študentkami ter njihovo telovadno samoučinkovitostjo in uspešnost. V raziskavi je prostovoljno sodelovalo 201 študent in 160 študentk ter njihovih 7 učiteljev. Študenti so obiskovali drugi letnik Visoke šole za telesno vzgojo in šport (SPESS) in so morali dva semestra opravljati predmet "Poučevanje telovadbe". Samoučinkovitost študentov smo ovrednotili z ustreznimi vprašalniki na začetku študijskega leta, ob koncu prvega semestra in ob koncu študijskega leta. Zahtevnost telovadnih prvin so ocenjevali učitelji, uspešnost študentov pa njihovi učitelji ob koncu prvega semestra in ob koncu študijskega leta. Glavne ugotovitve so bile: (a) oba spola sta med študijskim letom povečala svojo samoučinkovitost, medtem ko so imele ženske višjo splošno samoučinkovitost glede vseh telovadnih orodij kot moški v treh meritvah; (b) ni bilo razlik med spoloma v povprečju treh meritev samoučinkovitosti pri običajnih telovadnih prvinah; (c) ni bilo razlik v težavnosti telovadnih prvin, ki jih izvajajo moški in ženske, in (d) ženske so prejele višje ocene kot moški. Glede na omejitve raziskave so lahko ugotovitve zelo koristne za učinkovitejšo organizacijo in poučevanje univerzitetnih predmetov telovadbe.

Ključne besede: samoučinkovitost, orodna telovadba, moški, ženske, nastop.

ZAZNAVANJE MOTENJ PREHRANE PRI ORODNIH TELOVADCIH IN TELOVADKAH

Konstantina-Erifyli Papacharalampous**,** Costas Dallas, George Dallas

Namen raziskave je bil raziskati spremembe motenj hranjenja pri orodnih telovadcih in telovadkah. Študija je vključevala 23 telovadcev in 42 telovadk, starih od 7 do 27 let, iz športnih klubov po vsej Grčiji. Lestvica EAT-26 Diet Attitudes je bila uporabljena za raziskovanje prehranjevalnih navad udeležencev. Proces zbiranja podatkov je vključeval sporazumevanje s športnimi organizacijami po vsej Grčiji o vsebini in namenu raziskave. Po posvetovanju je bil vprašalnik zaradi pandemije COVID-19 posredovan v elektronski obliki in je vseboval tudi obrazec za soglasje za sodelovanje v raziskavi. Rezultati študije so pokazali, da je imelo enajst od petinšestdesetih telovadcev skupni rezultat >20 na EAT-26, kar je višja stopnja med telovadkami (~ 24 %) v primerjavi s telovadci (~ 4,4 %) ($p < .05$). Čeprav telovadke razvijejo več motenj hranjenja in bulimije kot telovadci, na podlestvicah vprašalnika ni bilo pomembnih razlik ($p > 0,05$). Zato zahteva ta ugotovitev v kombinaciji z dejstvom, da je bila večina telovadcev mladostnikov (15,23 ± 6,35 let) poseben pomen in pozornost vaditeljev in družinskega okolja.

Ključne besede: motnje hranjenja, lepi šport, mladostniki, nevrogena anoreksija, nevrogena bulimija

TAKOJŠNJI UČINEK MISELNEGA POSNEMANJA NA SAMOZAVEST IN ZMOGLJIVOST PRI IZVAJANJU SALTA STOJE NAZAJ PRI TELOVADCIH

Sarra Hammoudi Nassib, Dhouha Cherni,Sabra Hammoudi Riahi,Sameh Menzli Wali, Bessem Mkaouer

Namen te študije je bil preučiti skupni učinek miselnih podob in predstav na uspešnost, samozavest in samoocenjevanje med izvajanjem salta nazaj z mesta. Osemnajst telovadcev (starih 22,11 ± 1,71 let) je prostovoljno sodelovalo v tej raziskavi. Ko je bilo ogrevanje končano, so preiskovanci izvedli iz stoje snožno na pritiskovni plošči salto stoje, da bi določili temeljno zmogljivost pred vsako poskusno izvedbo. Nato so bili udeleženci naprošeni, naj se vključijo v dve miselni strategiji, in sicer miselne podobe in predstave za 1 minuto, tik preden so izvedli še en salto nazaj. Rezultati te študije kažejo, da je kombinirana miselno povzročilo izboljšanje uspešnosti izvajanja salta nazaj, pa tudi samozavesti in samoocenjevanja.

Ključne besede: salto nazaj skrčeno, miselno draženje, miselne podobe, predstave, samozavest, samoevalvacija.

Science Core Collection journals, including arts and humanities will have Journal Impact Factors

Company Release -

7/26/2022 3:03 AM ET

LONDON, July 26, 2022 /PRNewswire/ -- Clarivate Plc (NYSE: CLVT), a global leader in providing trusted information and insights to accelerate the pace of innovation, today announced that in the 2023 release of the Journal Citation Reports all Web of Science Core Collection™ journals will receive a Journal Impact Factor (JIF)™. This means expanding the JIF from Science Citation Index Expanded (SCIE)™ and Social Science Citation Index (SSCI)™ to include journals from the Arts and Humanities Citation Index (AHCI)™ and the multidisciplinary Emerging Sources Citation Index (ESCI)™.

The annual JCR release enables the research community, publishers and librarians to evaluate and compare the scholarly impact of the world's high-quality journals using a range of indicators, descriptive data and visualizations.

By expanding the JIF to all journals that have passed the rigorous Web of Science quality criteria, this latest enhancement helps level the playing field for all quality journals including recently-launched journals, open access journals, journals with a niche or regionally-focused scope and journals from the Global South.

It means that:

- Almost **9,000** journals – from more than 3,000 publishers, many of which are smaller publishers from the developing world – will have a JIF for the first time.
- There will be an **8% increase** in gold open access journals that will have a JIF.
- There will be a minimum **5% increase** in journals from the Global South[1] that will have a JIF.

In addition, the 2023 release of the Journal Citation Reports will display the JIF with one decimal place, rather than the current three decimal places, to encourage users to consider the other indicators and descriptive data in the JCR when comparing journals.

Dr Nandita Quaderi, Editor in Chief and Editorial Vice President, Web of Science said:
"To accelerate the pace of innovation research funders, institutions and researchers need to be able to make decisions based on quality data they can trust. We have made the decision to display Journal Impact Factors for all journals that are indexed in the Web of Science Core Collection as part of our ongoing commitment to the integrity of the scholarly record. Our rigorous selection process allows us to keep untrustworthy journals out of our

indexes, which coupled with our careful data curation means that the research community can rely on the data and metrics in the Journal Citation Reports.

"Giving all quality journals a Journal Impact Factor will provide full transparency to articles and citations that have contributed to impact, and therefore will help them demonstrate their value to the research community. This decision is aligned to our position that publications in all quality journals, not just highly cited journals, should be eligible for inclusion in research assessment exercises."
No changes will be made to the JCR until the next annual release in June 2023.

Ludo Waltman, professor of Quantitative Science Studies at the Centre for Science and Technology Studies (CWTS), Leiden University, the Netherlands said: "The JIF needs to co-evolve with the changing expectations of researchers, research managers and evaluators. I welcome the expansion of the JIF to all journals in Web of Science Core Collection. This is a significant step toward a more inclusive perspective on the journal landscape."

Dr Quaderi adds: "Community consultation on these changes has included individual discussions with publishers, librarians and bibliometricians as well as quantitative community surveys. We encourage anyone with further feedback on the changes to contact us at ISI@clarivate.com."

A history of responsible research evaluation and product innovation
The Institute for Scientific Information (ISI)™ at Clarivate has a long history of promoting integrity in research and evaluation. Through their Global Research Reports and academic papers, they have already explained what best practice for research evaluation should look like, from their 2019 report Profiles Not Metrics, to submitting evidence to the Parliamentary Science and Technology Select Committee in the UK and the EU Coalition for Reforming Research Assessment. The 2020 report Research Integrity: Understanding our shared responsibility for a sustainable scholarly ecosystem reviews the different kinds of behavior that undermine research integrity.
Each journal profile in the JCR provides a rich array of journal intelligence metrics and allows users to filter by category and rank. These include:

- The Journal Citation Indicator, which represents the average category-normalized citation impact for papers published in the prior three-year period. All journals in the JCR have been eligible to receive this metric from 2021
- The Immediacy Index, which measures how frequently the journal's content is cited within the same year as publication;
- The journal's rank in category, determined by Journal Impact Factor, expressed as a percentile;
- Cited half-life, which is the median age, in years, of items in the journal that were cited during the JCR year

In addition, the Journal Citation Reports include descriptive data such as open access content, top contributing institutions and regions.

To aid responsible researcher evaluation Clarivate provides comprehensive researcher profiles in the Web of Science that include a variety of metrics, from citations to peer review, Web of Science Author Impact Beamplots and full CVs which individuals can use to promote their full academic profile.

Notes to editors

What is the Emerging Sources Citation Index?
Journals included in the Emerging Sources Citation Index cover all disciplines and range from international and broad scope publications to those that provide deeper regional or specialty area coverage. More than 3 million records and 74.4 million cited references date back from 2005 to present. Part of the Web of Science Core Collection™, Emerging Sources Citation Index contains quality publications, selected by our expert in-house editors for editorial rigor and best practice at a journal level.

Visit the Journal Citation Reports website to explore all available data, metrics and analysis. You can find more information including our suppression policy in the Journal Citation Reports Reference Guide.
Follow us on Twitter via @ClarivateAG #JCR2023.

About Clarivate
Clarivate™ is a global leader in providing solutions to accelerate the pace of innovation. Our bold mission is to help customers solve some of the world's most complex problems by providing actionable information and insights that reduce the time from new ideas to life-changing inventions in the areas of Academia & Government, Life Sciences & Healthcare, Professional Services and Consumer Goods, Manufacturing & Technology. We help customers discover, protect and commercialize their inventions using our trusted subscription and technology-based solutions coupled with deep domain expertise. For more information, please visit clarivate.com.

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2021 Journal Performance Data for: Science of Gymnastics Journal

ISSN
1855-7171

EISSN
1855-7171

JCR ABBREVIATION
SCI GYMNAST J

ISO ABBREVIATION
Sci. Gymnast. J.

Journal Information

EDITION
Emerging Sources Citation Index (ESCI)

CATEGORY
SPORT SCIENCES - ESCI

LANGUAGES
English

REGION
SLOVENIA

1ST ELECTRONIC JCR YEAR
2020

Publisher Information

PUBLISHER
UNIV LJUBLJANA, FAC SPORT

ADDRESS
DEPT GYMNASTICS, GORTANOVA 22, LJUBLJANA SI-1000, SLOVENIA

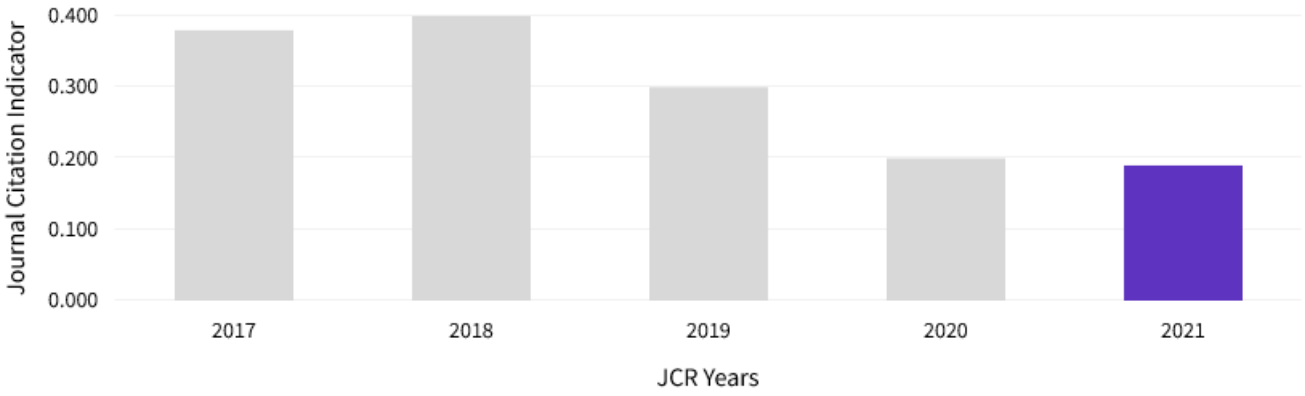
PUBLICATION FREQUENCY
3 issues/year

Journal's Performance

Journal Citation Indicator (JCI)

0.19

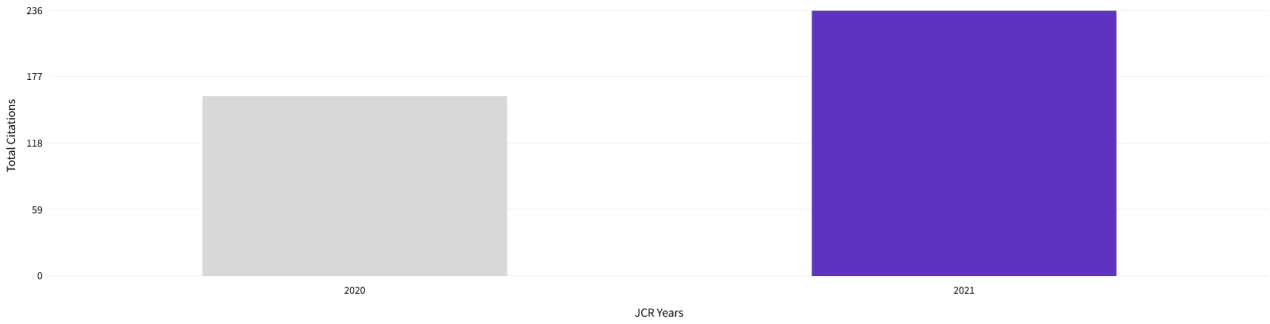
The Journal Citation Indicator (JCI) is the average Category Normalized Citation Impact (CNCI) of citable items (articles & reviews) published by a journal over a recent three year period. The average JCI in a category is 1. Journals with a JCI of 1.5 have 50% more citation impact than the average in that category. It may be used alongside other metrics to help you evaluate journals.



Total Citations

236

The total number of times that a journal has been cited by all journals included in the database in the JCR year. Citations to journals listed in JCR are compiled annually from the JCR years combined database, regardless of which JCR edition lists the journal.



Open Access (OA)

The data included in this tile summarizes the items published in the journal in the JCR data year and in the previous two years. For example, in the 2020 JCR data, released in June 2021, the Open Access (OA) data show the publication model (Gold OA or subscription) of materials published in 2018, 2019 and 2020, and citations in 2020 to these items. This three-year set of published items is used to provide descriptive analysis of the content and community of the journal.

Items

TOTAL CITABLE
98

% OF CITABLE OA
0.00%

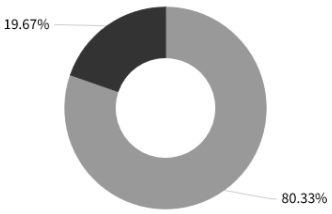
CITABLE

GOLD OPEN ACCESS
0 / 0.00%

SUBSCRIPTION OR BRONZE
98 / 80.33%

NON-CITABLE

OTHER (NON-CITABLE ITEMS)
24 / 19.67%



Citations*

TOTAL CITABLE
44

% OF CITABLE OA
0.00%

CITABLE

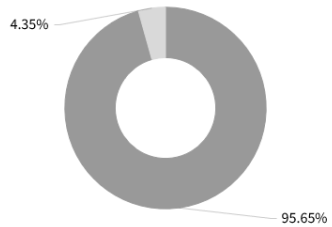
GOLD OPEN ACCESS
0 / 0.00%

SUBSCRIPTION OR BRONZE
44 / 95.65%

NON-CITABLE

OTHER (NON-CITABLE ITEMS)
0 / 0.00%

UNLINKED CITATIONS
2 / 4.35%



* Citations in 2021 to items published in (2019-2021)

Rank by Journal Citation Indicator (JCI)

Journals within a category are sorted in descending order by Journal Citation Indicator (JCI) resulting in the Category Ranking below. A separate rank is shown for each category in which the journal is listed in JCR. Data for the most recent year is presented at the top of the list, with other years shown in reverse chronological order.

Only journals which have a calculated JCI value are included in the JCI ranking. The total number of journals displayed in this ranking may be less than the category overall.

CATEGORY

SPORT SCIENCES

109/123

JCR YEAR	JCI RANK	QUARTILE	JCI PERCENTILE
2021	109/123	Q4	11.79
2020	100/116	Q4	14.22
2019	91/116	Q4	21.98
2018	80/115	Q3	30.87
2017	77/113	Q3	32.30

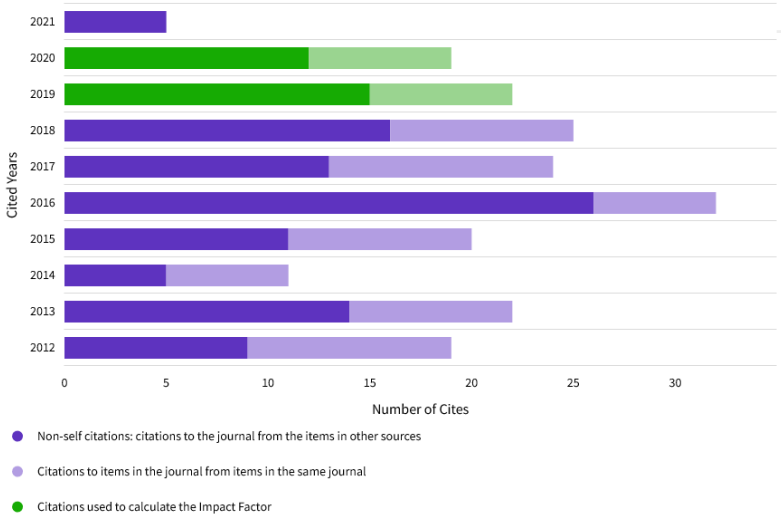
Citation network

Cited Half-life

5.7 years

The Cited Half-Life is the median age of the items in this journal that were cited in the JCR year. Half of a journal's cited items were published more recently than the cited half-life.

TOTAL NUMBER OF CITES	NON-SELF CITATIONS	SELF CITATIONS
236	151	85



# OF CITES FROM 2021	CUMULATIVE %	# OF CITING SOURCES
236 citations	**100.00%**	**67 sources**
5 citations	2.12%	3 sources
19 citations	10.17%	9 sources
22 citations	19.49%	13 sources
25 citations	30.08%	15 sources
24 citations	40.25%	12 sources
32 citations	53.81%	15 sources
20 citations	62.28%	10 sources
11 citations	66.94%	6 sources
22 citations	76.26%	14 sources
19 citations	84.31%	10 sources
Previous years: 37 citations		

Citing titles in all years

	SOURCE NAME	COUNT
	All Others	39
1	Science of Gymnastics Journal	85
2	International Journal of Environmental Research and Public Health	12
3	Pedagogy of Physical Culture and Sports	10
4	JOURNAL OF INTELLIGENT & FUZZY SYSTEMS	9
5	International Journal of Performance Analysis in Sport	6
6	SENSORS	6
7	Sports Biomechanics	6
8	Acta of Bioengineering and Biomechanics	5
9	PLoS One	5
10	Applied Sciences-Basel	4
11	BMC Sports Science Medicine and Rehabilitation	4
12	Frontiers in Psychology	4
13	Sports	4
14	Children-Basel	3
15	European Journal of Human Movement	3
16	Frontiers in Sports and Active Living	3
17	Kinesiologia Slovenica	3
18	Mobile Information Systems	3
19	Nutrients	3
20	Pensar en Movimiento-Revista de Ciencias del Ejercicio y la Salud	3

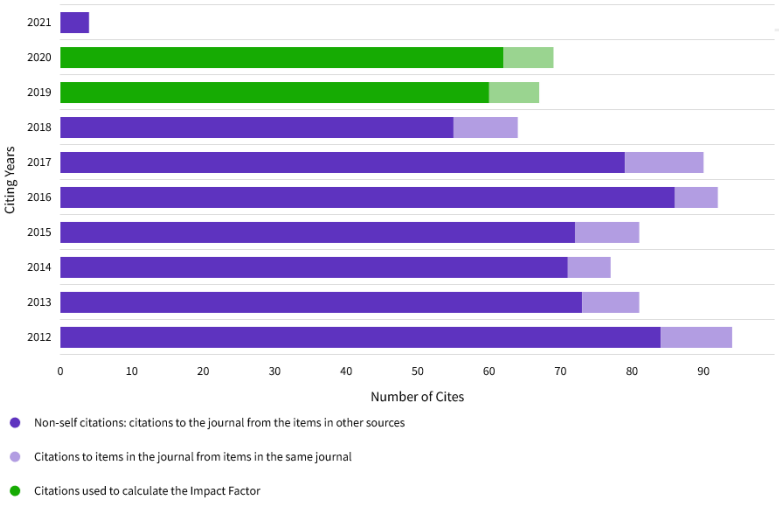
Showing 1 - 20 rows of 28 total (use export in the relevant section to download the full table)

Citing Half-life

9.9 years

The Citing Half-Life is the median age of items in other publications cited by this journal in the JCR year.

TOTAL NUMBER OF CITES	NON-SELF CITATIONS	SELF CITATIONS
1,413	1,328	85



# OF CITES FROM 2021	CUMULATIVE %	# OF CITED SOURCES
1,413 citations	**100.00%**	**621 sources**
4 citations	0.28%	2 sources
69 citations	5.16%	43 sources
67 citations	9.90%	39 sources
64 citations	14.43%	37 sources
90 citations	20.80%	60 sources
92 citations	27.31%	59 sources
81 citations	33.04%	47 sources
77 citations	38.49%	46 sources
81 citations	44.22%	50 sources
94 citations	50.87%	52 sources
Previous years: 694 citations		

Cited titles in all years

Science of Gymnastics Journal

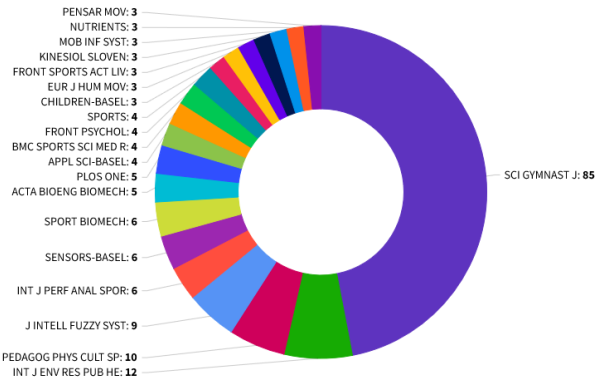
	SOURCE NAME	COUNT
	All Others	387
1	Science of Gymnastics Journal	85
2	JOURNAL OF STRENGTH AND CONDITIONING RESEARCH	41
3	MEDICINE & SCIENCE IN SPORTS & EXERCISE	35
4	JOURNAL OF SPORTS SCIENCES	29
5	BRITISH JOURNAL OF SPORTS MEDICINE	23
6	Journal of Human Kinetics	22
7	SPORTS MEDICINE	21
8	PERCEPTUAL AND MOTOR SKILLS	19
9	JOURNAL OF SPORT & EXERCISE PSYCHOLOGY	18
10	JOURNAL OF SPORTS MEDICINE AND PHYSICAL FITNESS	17
11	PSYCHOLOGY OF SPORT AND EXERCISE	17
12	EUROPEAN JOURNAL OF APPLIED PHYSIOLOGY	16
13	International Journal of Sports Physiology and Performance	13
14	PLoS One	13
15	SCANDINAVIAN JOURNAL OF MEDICINE & SCIENCE IN SPORTS	13
16	Sports Biomechanics	13
17	RESEARCH QUARTERLY FOR EXERCISE AND SPORT	12
18	BIOLOGY OF SPORT	11
19	European Journal of Sport Science	9
20	INTERNATIONAL JOURNAL OF SPORTS MEDICINE	9

Showing 1 - 20 rows of 144 total (use export in the relevant section to download the full table)

Journal Citation Relationships

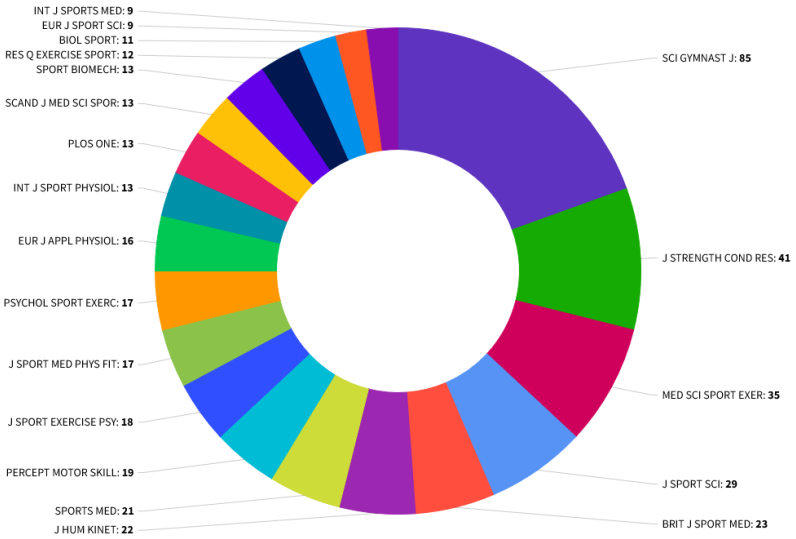
Cited Data

Top 20 journals citing SCI GYMNAST J by number of citations



Citing Data

Top 20 journals cited by SCI GYMNAST J by number of citations



Content metrics

Source data

This tile shows the breakdown of document types published by the journal. Citable Items are Articles and Reviews. For the purposes of calculating JIF, a JCR year considers the publications of that journal in the two prior years.

40 total citable items

	ARTICLES	REVIEWS	COMBINED (C)	OTHER DOCUMENT TYPES (O)	PERCENTAGE
NUMBER IN JCR YEAR 2021 (A)	38	2	40	8	83%
NUMBER OF REFERENCES (B)	1,299	114	1,413	0	100%
RATIO (B/A)	34.2	57.0	35.3	0.0	

Contributions by Organizations

Organizations that have contributed the most papers to the journal in the most recent three-year period.

RANK	ORGANIZATION	COUNT
1	NATIONAL & KAPODISTRIAN UNIVERSITY OF ATHENS	13
2	UNIVERSIDADE DE SAO PAULO	7
3	UNIVERSIDADE ESTADUAL DE CAMPINAS	6
4	UNIVERSITE DE LA MANOUBA	5
-	UNIVERSITY OF LJUBLJANA	5
6	COMENIUS UNIVERSITY BRATISLAVA	4
-	LEIPZIG UNIVERSITY	4
-	UNIVERSITY OF BIELEFELD	4

Showing 1 - 8 rows of 149 total (use export in the relevant section to download the full table)

Contributions by country/region

Countries or Regions that have contributed the most papers to the journal in the most recent three-year period.

RANK	COUNTRY/REGION	COUNT
1	Brazil	18
2	Greece	14
3	GERMANY (FED REP GER)	13
4	England	8
-	Slovenia	8
6	Spain	7
7	Slovakia	6
-	USA	6

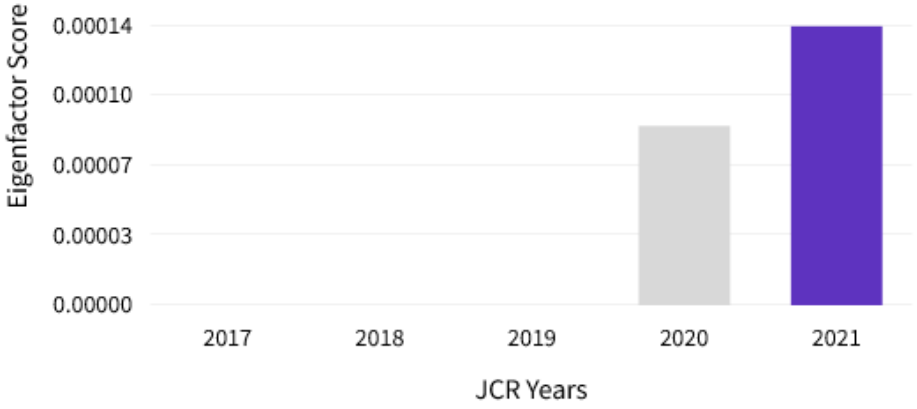
Showing 1 - 8 rows of 37 total (use export in the relevant section to download the full table)

Additional metrics

Eigenfactor score

0.00014

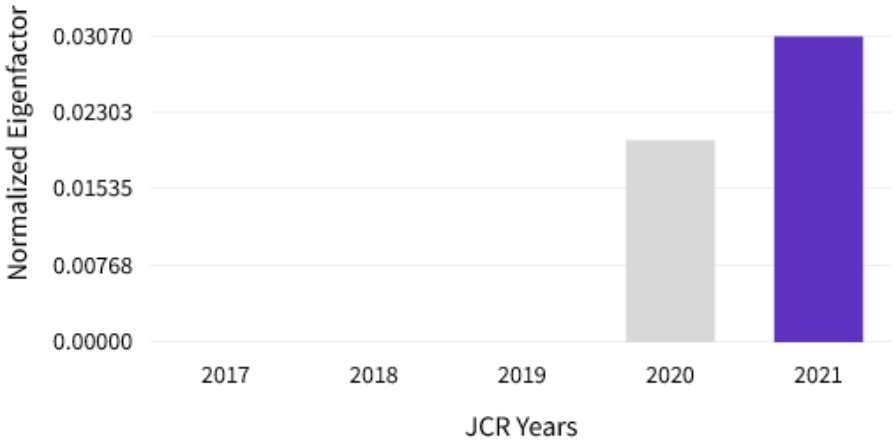
The Eigenfactor Score is a reflection of the density of the network of citations around the journal using 5 years of cited content as cited by the Current Year. It considers both the number of citations and the source of those citations, so that highly cited sources will influence the network more than less cited sources. The Eigenfactor calculation does not include journal self-citations.



Normalized Eigenfactor

0.03070

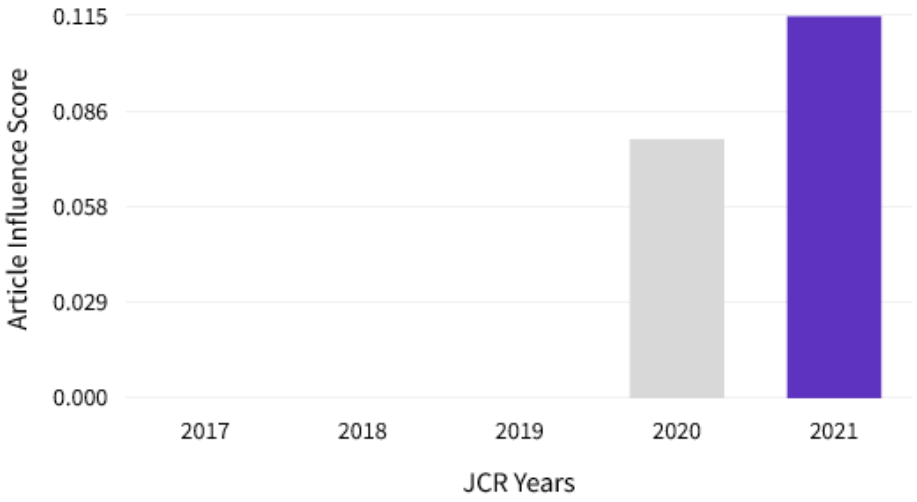
The Normalized Eigenfactor Score is the Eigenfactor score normalized, by rescaling the total number of journals in the JCR each year, so that the average journal has a score of 1. Journals can then be compared and influence measured by their score relative to 1.



Article influence score

0.115

The Article Influence Score normalizes the Eigenfactor Score according to the cumulative size of the cited journal across the prior five years. The mean Article Influence Score for each article is 1.00. A score greater than 1.00 indicates that each article in the journal has above-average influence.



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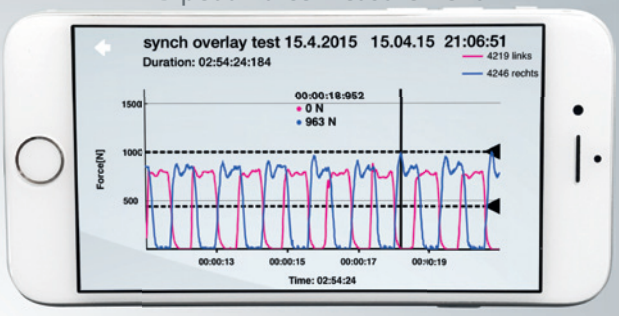
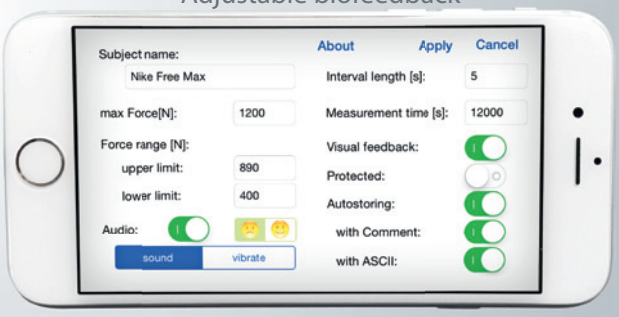


Adjustable biofeedback



art science

All systems from novel operate with high quality, calibrated sensors and provide reliable and reproducible results.

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